

# Micronesian Reef-associated Gastropods

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THIS REPORT is a synopsis of existing knowledge of the ecology and zoogeography of Micronesian reef-associated gastropods. It summarizes for each species the environmental conditions in which living specimens have been found, and it outlines the recent geographic occurrence of each species throughout the entire Indo-Pacific region (see Plate 4). Brief descriptions of the shells, with illustrations of some of them and reference to published figures for all of them, are also included. The report is intended both as an aid to research by others and as a guide for future collectors. It is based mainly on the notes and collections of field parties whose work in Micronesia since 1945 has increased both the data and the demand for such a summary.

The fact that a similar study has not been made before reflects, perhaps, the paucity of ecologic data in previous collections. Indeed, the extensive Indo-Pacific mollusk collection in the U. S. National Museum, which so substantially supplemented the zoogeographic and systematic parts of this paper, is almost devoid of ecologic records for specimens collected earlier than about 1945.

The information summarized here is surely not the complete or final story for the gastropods. Originally it was hoped to include the pelecypods as well, and, in addition, to attempt a more comprehensive general analysis of the whole group; but time did not permit such a complete study, and it is hoped that these aspects of the gastropods will be covered in later publications.

## SOURCES OF DATA

The ecologic data on which this study is based are taken from eight collections of mollusks made in Micronesia since 1944, comprising about 12,000 lots and over 200,000 specimens. The collections are from Onotoa Atoll in the Gilbert Islands, from Saipan in the Mariana Islands, from Yap and Ifaluk in the West Caroline Islands, and from Bikini, Eniwetok, Rongerik, Rongelap, Arno, and Majuro atolls in the Marshall Islands. All of these islands lie within the geographic area of Micronesia, as outlined in Plate 4. Details regarding principal collectors, sponsoring organizations, size of collections, and dates of field studies are given in Table 1. These collections have been added to those in the U. S. National Museum.

Geographic distribution data, shell measurements and descriptions, and estimates of relative abundance are based on the entire Indo-Pacific collection in the U. S. National Museum.

Supplementary information, zoogeographic, systematic, and ecologic, has been obtained from published records and from personal communications. For the ecologic summaries, unless otherwise specified, only data referring to specimens taken alive or obviously recently dead were accepted, in order to be reasonably sure that the species actually lived in the environment described for them.

## ACKNOWLEDGMENTS

So many people have contributed to this study in one way or another that it is impossible to list them all. Thanks go to every-

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TABLE 1  
RECENT MICRONESIAN COLLECTIONS OF GASTROPODS INCLUDED IN THIS STUDY

AREA	SPONSORING ORGANIZATION	FINANCIAL SPONSORSHIP	DATE	PRINCIPAL COLLECTORS	NUMBER OF LOTS	NUMBER OF SPECIMENS
Ifaluk Atoll, Caroline Islands	Pacific Science Board, National Research Council	Office of Naval Research	1953	Frederick M. Bayer, U. S. National Museum	417	2,000
Onotoa Atoll, Gilbert Islands	Pacific Science Board, National Research Council	Office of Naval Research	1951	Preston E. Cloud, Jr., U. S. Geological Survey; Donald E. Strasburg and A. H. Banner, University of Hawaii	301	4,000
Arno Atoll, Marshall Islands	Pacific Science Board, National Research Council	Office of Naval Research	1950	Robert W. Hiatt, University of Hawaii		
Yap Island, Caroline Islands	University of Hawaii	University of Hawaii	1945	Robert W. Hiatt, University of Hawaii	324	3,000
Saipan, Mariana Islands	U. S. Geological Survey	U. S. Army, Corps of Engineers	1949	Preston E. Cloud, Jr., U. S. Geological Survey	124	500
Bikini, Eniwetok, Rongerik, and Rongelap atolls, Marshall Islands	U. S. Armed Forces studies in connection with Operation Crossroads		1946	Joseph P. E. Morrison, U. S. National Museum	10,000	200,000
Bikini, Eniwetok, Rongerik, and Rongelap atolls, Marshall Islands	as above		1947	Joseph P. E. Morrison, U. S. National Museum	650	9,000
Eniwetok Atoll, Marshall Islands	as above		1952	Harry S. Ladd, Martin Russell, and R. C. Townsend, U. S. Geological Survey	67	153

one connected with the Micronesian field studies, especially to the principal collectors named in Table 1. Without them the paper could not have been written at all, since it is mainly a compilation and condensation of their field notes.

Dr. Preston E. Cloud, Jr., Chief, Paleontology and Stratigraphy Branch, U. S. Geological Survey, outlined, supervised, and inspired the project. Without his unfailing support it never would have materialized.

For his encouragement, his advice on systematics, and for providing office space and access to the National collections, I wish to thank Dr. Harald A. Rehder, curator of the Division of Mollusks, U. S. National Museum.

To Mr. Frederick M. Bayer, U. S. National Museum, I am grateful for his patient descriptions of collecting localities and his many kind suggestions.

Dr. R. Tucker Abbott, now at the Philadelphia Academy of Natural Sciences, offered much helpful direction and assistance until and after his departure from the National Museum.

Dr. J. P. E. Morrison, also of the U. S. National Museum, supplied ecologic information and advice.

Miss Carolyn Bartlett, U. S. Geological Survey, prepared the beautiful pen and ink drawings that comprise Figures 1-42 of this report, taking special pains to render the color patterns in monochrome. Mrs. Elinor Stromberg, U. S. Geological Survey, drew the Indo-Pacific map.

Dr. Robert G. Schmidt, U. S. Geological Survey, gave tireless editorial assistance and encouragement.

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#### GENERAL CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

This report reveals how little is known of the habits of these mollusks. We can hardly begin to understand them without much more extensive field and laboratory studies on such problems as optimum environmental requirements, nutrition, feeding methods, reproduction, egg laying, larval development, growth rates, and anatomy. However, any collector, by keeping accurate detailed notes, can help to answer many questions. The following outline of suitable observations, which could be expanded almost endlessly, is suggested:

##### *Condition of specimen*

- Alive
- Recently dead
- Beachworn

##### *Habitat*

- Oceanward
  - Seaward reef flat
  - Seaward reef edge
  - Surge channel
  - Offshore ocean water (depth)
- Other

##### Lagoonward

- Lagoon reef flat
- Lagoon shelf (depth)
- Lagoon slope (depth)
- Lagoon floor (depth)
- Lagoon reef patch
- Other

##### *Substrate*

- Inorganic
  - Sand
  - Mud
  - Rocks
  - Other

##### Organic (living or dead?)

- Coral (species?—collect for identification)
- Soft coral (species?—collect for identification)
- Seaweed (species?—collect for identification)
- Mollusks (species?—collection for identification)

- Mangrove roots
- Other
- Relation to substrate*
  - Buried (depth)
  - Attached (method)
  - Living in crevices, crannies, potholes, tide-pools
  - Burrowed (e.g., in coral)
  - Other
- Relation to tide*
  - Intertidal
  - Above high tide line (distance)
  - Below low tide line (depth)
- Type of water*
  - Active breaking surf
  - Surging water
  - Calm, protected water
  - Other
- Living habits observed*
  - Solitary or gregarious
  - Nocturnal or diurnal
  - Method of feeding
  - Food (algae, detritus, other organisms—preserve for identification)
  - Method of locomotion
  - Associations with other organisms (if any—preserve for identification)
    - Apparent relationships
      - Parasitism
      - Commensalism
      - Accidental
  - Reproduction
    - Breeding habits
    - Egg-laying procedure
    - Egg protection or brooding habit (e.g., egg case of *Natica* or brooding habit of *Quoyula*)
- Enemies observed*
  - Fish
  - Birds
  - Mammals
  - Invertebrates (e.g., starfish, other mollusks)
- The living mollusk*
  - Appearance, particularly color which fades with preservation
  - Collect soft parts for anatomical study

During the present study it was realized that a single collection by a single worker is likely to give a misleadingly circumscribed picture of a fauna, owing to individual methods and interests. For instance, one person may collect mainly along the shore while another collects principally by diving offshore. It is believed that the present approach, that of compiling information from several collecting methods and viewpoints, is a better one. Since these collections include species from many ecologic zones, a summary of the data of their several collectors presents a more realistic view of Micronesian gastropod ecology than would be likely to result from the notes or efforts of a single collector.

In drawing up the geographic ranges, it became obvious that there are several faunal breaks in the Indo-Pacific region. Time was not available for analysis of these divisions but the basic data are included in the hope that other investigators may take it up. Particularly apparent, however, was the fact that although many species range widely from east to west, almost none of the species occurred farther north than southern Honshu Province, Japan, or farther south than northern Australia. Breaks recognized are almost certainly related to temperature patterns and ocean currents.

It was observed that many species whose geographic distribution is extremely wide are recorded as having pelagic larval stages (for instance many of the Cypraeidae and Cymatiidae, e.g., *Cypraea isabella* and *Cymatium chlorostomum*). It would be of great interest to learn the length of these free-swimming larval stages. Again, it was intended to draw up patterns of zoogeographic distribution and to correlate them with what is known of larval types, but here, too, lack of time precluded such analysis.

Throughout the study, the occurrence of each species around atolls, high islands, and continental shores was noted. The results for a few species (e.g., *Trochus maculatus*, *Nerita*

*undata*, *Monodonta labio*) imply that these species live only on a muddy substrate such as that found adjacent to high, volcanic islands and continental shores, and that they are not found on the limesand substrate of atolls (or similar parts of other shallow tropic seas). The fact that most species are recorded equally from atolls, high islands, and along continental shores suggests that most of the collections studied are taken from reefs or reef-associated limesands and not from sites strongly influenced by volcanic or terrestrial sedimentation.

#### SYSTEMATIC ANALYSES

##### *Procedures*

Only gastropods in the recent Micronesian collections mentioned are considered in this study. They number 175 species, grouped in 53 genera, and representing 25 families. Because of collecting areas and methods, they are almost exclusively shallow-water forms, which live on or in close association with reefs. The summary provided for each species includes the name apparently regarded as most acceptable by practicing specialists, reference to a convenient published illustration or a drawing made especially for the present work, a brief description of the shell, its ecology as presently understood, its geographic range in the Indo-Pacific, and its abundance in Micronesia.

##### *Taxonomic Arrangement*

The brief descriptive notes are intended purely as a field aid to species recognition and not as definitive descriptions or revisions. This is not a taxonomic paper. In general, the systematic arrangement of families and genera is according to Thiele (1929 and 1931). Species are listed alphabetically under each genus. For species which have commonly been recognized by several names, their well-known synonyms are listed parenthetically. The Mitridae are arranged after Dautzenberg (1935), and the Cypraeidae, for the most part, after Schilder (1938). In some instances, where

previous authors have subdivided families into many genera which have not gained complete acceptance, those genera are used here as subgenera. For instance, in the Cypraeidae the generic name *Cypraea* is used throughout, whereas the generic names of Schilder (1938) are included as subgenera. In other groups, such as the Conidae and Terebridae, subgeneric names are excluded entirely.

##### *Shell Illustration and Description*

As far as possible, reference to a good illustration of each species is provided. Such references are to readily available texts, most frequently to *A Handbook of Illustrated Shells* by Hirase and Taki (1951), *Pacific Sea Shells* by Tinker (1952), *A Field Guide to Shells of the Pacific Coast and Hawaii* by Morris (1952), and to *Coloured Illustrations of the Shells of Japan* by Kira (1955). In a few instances reference is made to "Shells Take You over World Horizons," an article by Platt in the *National Geographic Magazine* (July, 1949).

When an accurate illustration is not available in a convenient reference, pen and ink drawings prepared by Carolyn Bartlett of the U. S. Geological Survey are furnished. Forty-two species are thus illustrated with original drawings; most of these species appear to have been rarely collected although some of them are common or even very common in Micronesia. In these original drawings, the scale marks beside the figures represent one centimeter.

These illustration references and original pen and ink drawings are supplemented by brief descriptions of the shells. For each species, a characteristic shell length is given. In most instances, shell color is noted, particularly if the illustration is in black and white. Obvious sculptural features are also mentioned. For species which are commonly confused with other species, distinguishing characteristics are noted.

##### *Ecologic Summaries*

The ecology of each species is compiled from data accompanying the eight Microne-

sian collections previously mentioned. In instances where these collections contain only one or two specimens of a species, the specific collecting data are presented with no attempt at generalization. Unless otherwise qualified, only data referring to specimens taken alive were used. Where observations by collectors are given, e.g., "Bayer reports," with no citation of a publication, the information was obtained by personal communication. For some species, additional remarks from the U. S. National Museum collections and from published accounts for other Indo-Pacific areas are included. Mention is made of associations with other mollusks or other invertebrates, whenever such associations have been reliably reported.

### Reef Terminology

In the ecologic notes, an attempt is made to describe reef environments in terms that are self-explanatory and comprehensible to the lay reader as well as to the trained scientist. The aim is to avoid terms that are too specific to apply to reefs in general, since detailed reef characteristics vary from island to island. By and large, the terminology outlined by Tracey, Emery, and Cloud (1955) comes the nearest to that followed here; and for the reader's convenience, their figure 1 is reproduced here, with a few emendations, as Plate 3.

In these discussions, a *Seaward Reef Flat* (Tracey, *et al.* Reef Flat) is the upper surface of an ocean-facing reef. It is also called here an *Ocean Reef Flat*. A *Seaward Reef Flat* is generally broad and well-developed. Its shoreward area (Tracey, *et al.* Inner Reef Flat) is usually intertidal and thus is exposed at low tide, commonly with rocks left standing in residual pools; it is covered by a few feet of

water at high tide. Species living in this zone are adapted to periodic exposure or live in tide pools where they are always in water. Because of its variety of habitats, this intertidal part of the *Seaward Reef Flat* is well populated by many species representing several different families.

The seaward part of the *Ocean Reef Flat* (Tracey, *et al.* Outer Reef Flat) is the area immediately shoreward of the *Reef Edge*. It is ordinarily a zone of circulating water but not of heavily breaking surf; it is typically below low tide line and thus is covered by a few inches to a few feet of water at low tide. Species living in this zone are usually never exposed, even at low-low tide. This part of the reef flat is also well populated.

The *Seaward Beach* is at the shoreward-most edge of the *Seaward Reef Flat*. It is characteristically above high tide line. Species which live on or near the *Seaward Beach* (e.g., *Littorina* spp.) are able to survive long periods of exposure to the air. Few species are so adapted; consequently the *Seaward Beach* is sparsely populated. However, empty shells of species living in other areas may be found here.

The *Reef Edge* (Tracey, *et al.* Seaward Reef Margin) is the seaward margin of the *Seaward Reef Flat*. It is intertidal and thus is dry, except for spray, at low tide. The *Reef Edge* is exposed to a heavy surf. Consequently, species living in this habitat must be adapted to withstand the shock of violent wave action. Gastropods living on the *Reef Edge* commonly have a strong muscular foot with which they cling to their precarious homesite (e.g., *Patella stellaeformis*, *Trochus maculatus*). Other workers have called the *Reef Edge* a reef crest, coralline ridge, algal ridge, and *Litbothamnion* ridge. Elongate surge channels or shallow passes indent the *Reef Edge*.

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PLATE 1. Truncated and flourishing seaward reef flats. *Above*: Rock surface with patchy thin algal veneer backed at right by beach of alternating loose sand (light) and pitted coral-algal limestone (dark). Embayed windward reef edge and algal ridge at left curves around in distance, Onotoa Atoll, Gilbert Islands. Photograph by P. E. Cloud, Jr. *Below*: Flourishing coral growth at surface of leeward ocean reef without algal ridge, Bikini Atoll, Marshall Islands. Photograph by J. I. Tracey, Jr.



PLATE 1

The *Reef Front* is the shoreward face of a seaward reef, extending from the *Reef Edge* to depths of  $\approx 60$  feet, the approximate dwindle point of flourishing coral growth. This habitat is ordinarily one of abundant living coral and other reef-building organisms. The shoreward part of the *Reef Front* is characterized by turbulent water, particularly on a windward reef.

The *Outer Slope* is the steeply descending seaward face of a seaward reef, extending from  $\approx 60$  feet (the depth of marked dwindling of abundant living coral and coralline algae) to the deepest seaward portion of the reef. It is a habitat of few or no reef-building organisms, except at the transitional depth of approximately 60 feet. These deeper zones, the *Reef Front* and *Reef Slope*, are seldom mentioned in this report, since, because of collecting methods, most of the gastropods treated here live intertidally or in relatively shallow water.

A *Lagoon Reef Flat* borders the lagoon side of an island. It includes the intertidal zone and depths of a few feet below low tide line. It is generally a poorly developed, narrow reef, characterized by quiet water and sparse coral growth—quite a different environment from a *Seaward Reef Flat*. However, windward *Lagoon Reef Flats* of broad atolls, such as Bikini and Eniwetok, commonly exhibit features similar to those of a *Seaward Reef Flat*, because the long fetch of these lagoons allows the development of surf along the windward shore. Consequently species which typically inhabit *Seaward Reef Flats* are occasionally found living on these well-developed *Lagoon Reef Flats* (e.g., *Drupa morum*, *Drupa ricinus*).

Quite often there is no reef on the lagoon shore. Instead there is a *Lagoon Shelf*. A *Lagoon Shelf* is a gently sloping lagoon shore, including the intertidal zone and depths of a few

feet, and sometimes extending as deep as 20 feet into the lagoon. The *Lagoon Shelf* is predominately covered with sand or detrital matter rather than by reef-building organisms. Often growing on this sandy shelf, and offering protection to animals, are seaweeds or small reefs. Gastropods which live on the *Lagoon Shelf* commonly burrow into the sand among eelgrass roots or at the base of small reefs (e.g., *Terebra* spp.).

A *Lagoon Reef Edge* (Tracey, *et al.* Lagoon Reef Margin) is the lagoonward margin of a *Lagoon Reef Flat*. In some places the *Lagoon Reef Edge* is entirely absent. In others, it is ill-defined. In still others, such as the broad atolls of Bikini and Eniwetok, it is well developed and exhibits characteristics comparable to a *Seaward Reef Edge*.

A *Lagoon Slope* is a steeply sloping lagoon border extending from the lower or lagoonward edge of the *Lagoon Shelf* or *Lagoon Reef Flat* to the *Lagoon Floor*. The *Lagoon Floor* is the more or less level bottom of a lagoon.

Subsidiary reefs and minor organic prominences which grow up from lagoon shelves, slopes, and floors are variously shaped as mounds, platforms, knolls, or pinnacles. Many are flat-topped. Names that have been used for such features are patch reefs, reef knolls, and coral knolls. In the present report, because of divergence in collecting notes, these structures are all referred to simply as *Small Lagoon Reefs*.

#### Zoogeographic Distribution

An outline of the geographic occurrence of each species is given. Such distributional patterns have never previously been assembled for the Indo-Pacific mollusks. Perhaps they will provide a point of departure for future work in zoogeography.

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PLATE 2. Protected seaward reef margin and reef front pinnacle, Ine, Arno Atoll, Marshall Islands. Photographs by P. E. Cloud, Jr. *Above*: Close view at low tide of irregular edge of seaward reef margin, showing abrupt drop to depths at right. Brown, rose, and golden *Pocillopora elegans* (Dana) and gold, tan, and pink *Acropora humilis* (Dana) dominate the scene. *Below*: Underwater view of small pinnacle along and joined to the reef front a few feet below the surface. *Pocillopora*, *Acropora*, and (at the top) the hydrozoan *Millepora tenera* Boschma are prominent.



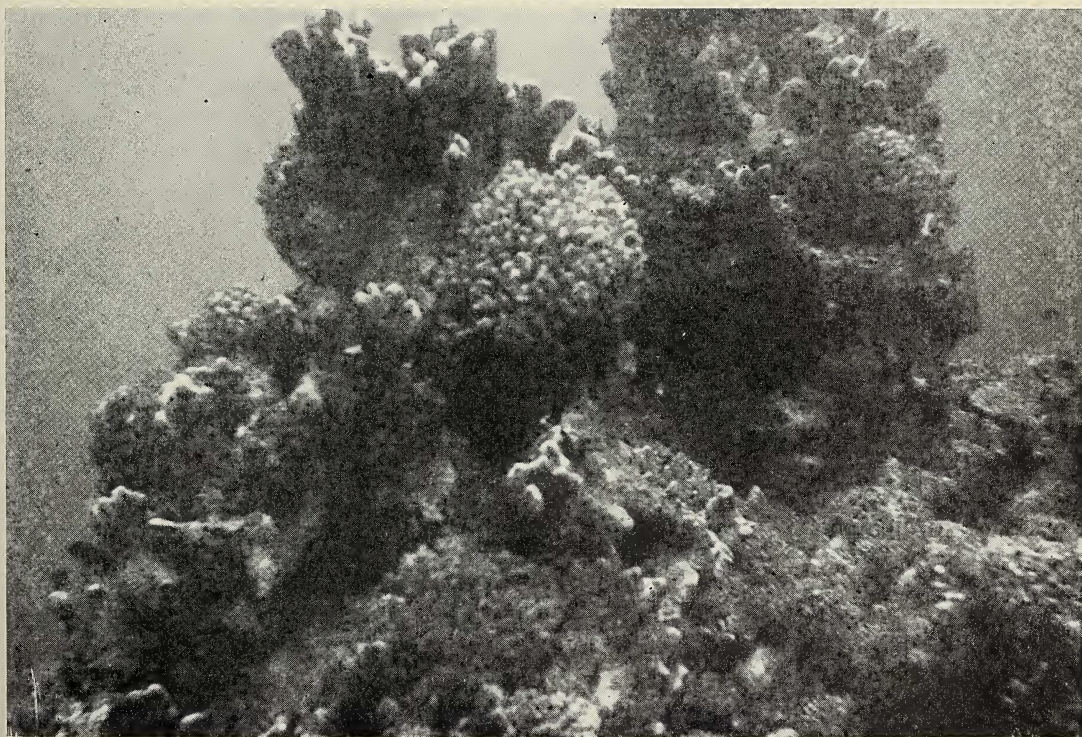
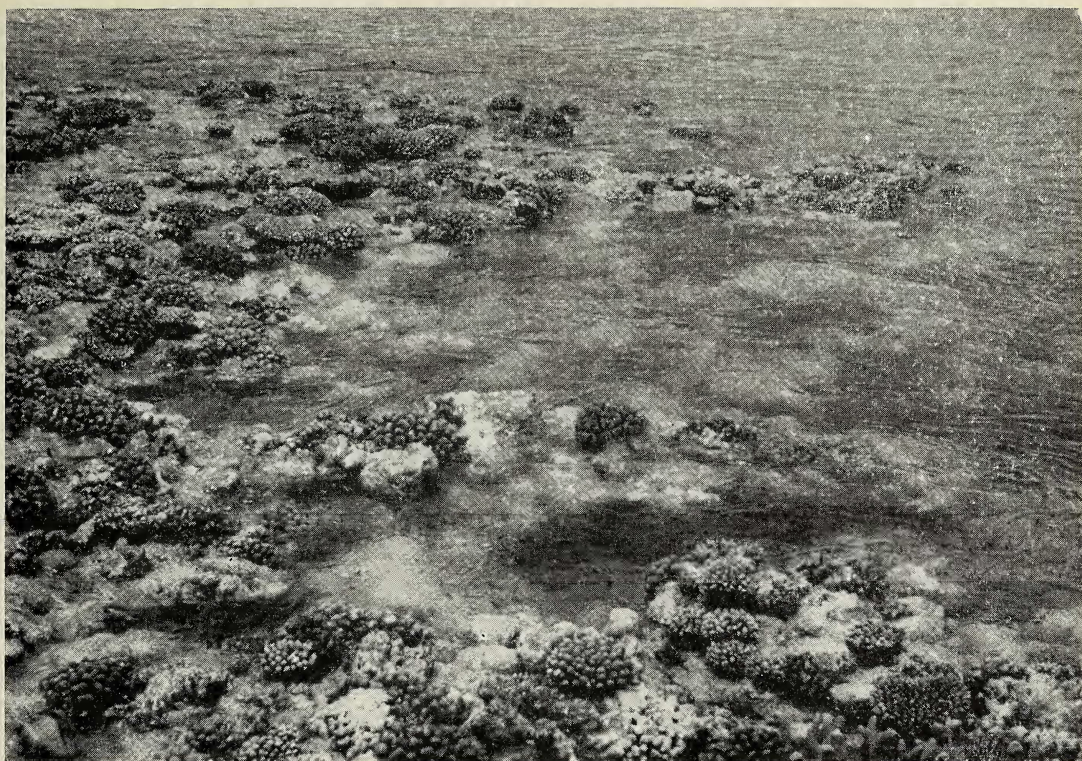


PLATE 2

These geographic ranges are based primarily upon an exhaustive examination of the entire Indo-Pacific collection in the U. S. National Museum. In the interest of accuracy, only records by collectors known to be reliable are included. If a range is represented solely by specimens in the Museum, this fact is indicated by a phrase such as "U. S. N. M. collections are from." If the Museum collections contain but a few specimens of a given species, the specific localities are enumerated.

In order to expand the distributional patterns for many species, dependable published sources were consulted. Unless otherwise specified, the Australian records are based upon Allan (1950), Hawaiian records upon Tinker (1952), records from the Philippines upon Faustino (1928), from "southern Japan" (this term refers to Kyushu Province) and the Ryukyu Islands upon Kuroda and Habe (1952). Formosan records were taken from Kuroda (1941), and records for East Africa, the Seychelles, and Madagascar are from von Martens (1880). Particularly useful in completing the ranges of the Terebridae, Mitridae, and Conidae were the publications of Dautzenberg (1935, 1937). Where the nomenclature of a species is in doubt, only National Museum records are cited, with no reference to published reports.

Each species is described as "common," "fairly common," or "uncommon" in Micronesia, based upon the frequency of its occurrence in the National Museum collections. These terms lack precision but give some indication of relative abundance.

#### DISCUSSIONS OF THE SPECIES

##### Family PATELLIDAE—Limpets

##### Genus PATELLA Linné, 1758

*Patella stellaeformis* Reeve, 1842.

Hirase and Taki (1951) pl. 57, fig. 2.

Characteristically 1 to 1.25 inches long and bright yellow within.

*P. stellaeformis* typically is found attached to exposed rocks of intertidal reef flats, frequently nestled in rock crevices. It is found most commonly on seaward reefs along, or just shoreward of, the reef edge, but occasionally it occurs near the edge of lagoon reef flats. Adaptations to its precarious environment are its muscular foot, with which it clings to the rocks, and its streamlined shell, which offers little resistance to the breaking waves. Ordinarily its shell is camouflaged by an overgrowth of coralline algae, vermetids, and other encrustations so that it blends with its similarly encrusted rocky substrate. Like most limpets, *P. stellaeformis* is herbivorous, and uses its radula to scrape algae from the rock surfaces.

GEOGRAPHIC RANGE: USNM collections are from southern Japan, and from the Mariana, Marshall, Gilbert, Caroline, Loyalty, Samoan, Cook, Society, and Tuamotu islands. Reported from Formosa and the Philippines but not from Australia or Hawaii. Common in Micronesia.

##### Family TROCHIDAE—Top Shells

##### Genus MONODONTA Lamarck, 1801

*Monodonta labio* (Linné, 1758).

Hirase and Taki (1951) pl. 66, fig. 8.

Characteristically 1.25 to 1.5 inches long, with purple and black beading and silvery white within the aperture.

The recent Micronesian collections contain only two specimens. Both were found living among intertidal rocks on the beach at Tomil Harbor, Yap.

GEOGRAPHIC RANGE: USNM collections are from the south China coast, southern Japan, the Ryukyu, Philippine, and Caroline islands, Borneo, and northern Australia. Reported from Madagascar but not from Hawaii. Uncommon in Micronesia. *M. labio* apparently is found along continental shores and high islands but not along the shores of atolls.





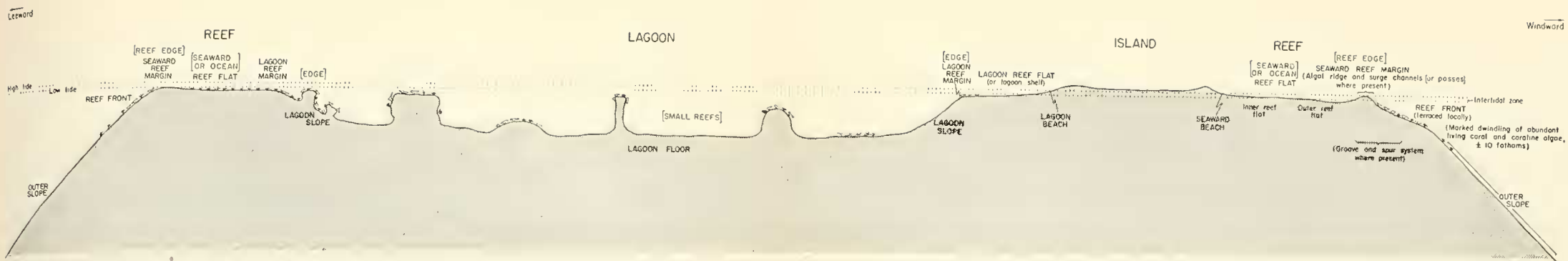


PLATE 3. The conspicuous features of an atoll and its peripheral reef (after Tracey, Cloud, and Emery, 1955). Hypothetical section, not to scale. Principal features are shown in capital letters; other features, subdivisions, and explanatory notes are indicated in lower-case letters. Terms enclosed in brackets are the ones that have been used in this report.

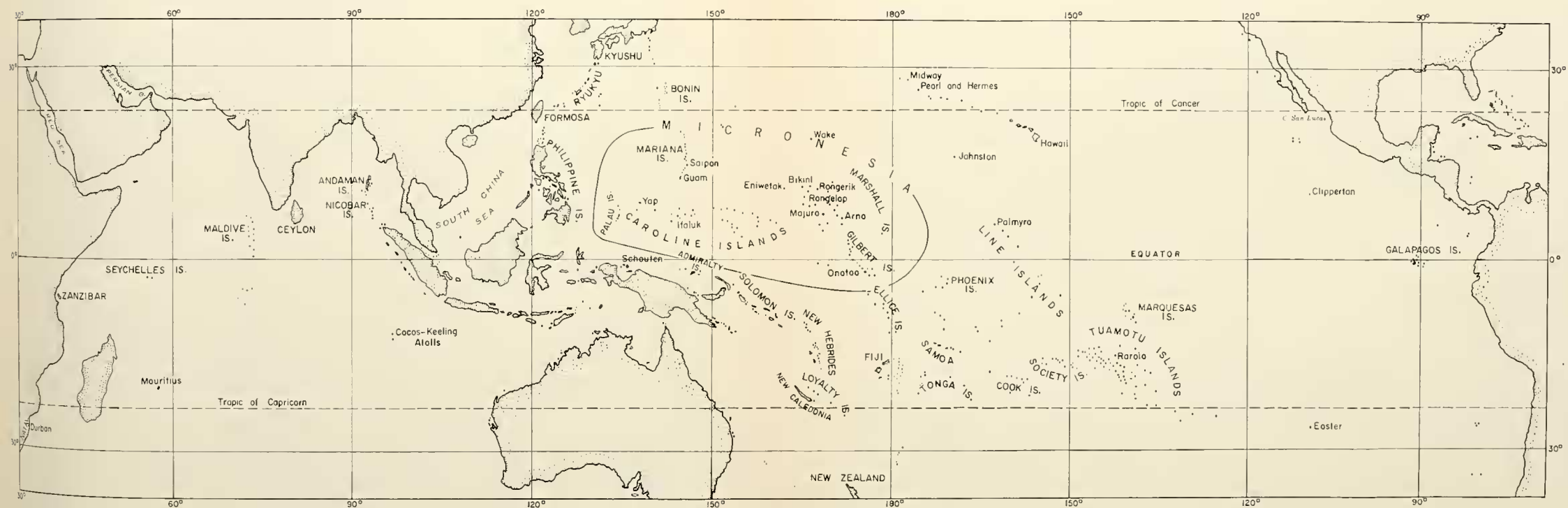


PLATE 4. Index map of the Indo-Pacific Region.



Genus TECTUS Montfort, 1810

*Tectus pyramis* (Born, 1780) (syn. *obeliscus* Gmelin, 1791; *acutus* Lamarck, 1822; *tabidus* Reeve, 1861).

Hirase and Taki (1951) pl. 65, fig. 8.

Characteristically 2.5 to 3.5 inches long, white or grayish, and possessing a heavy, conspicuous columellar fold.

Ordinarily found in rock crevices near the edge of seaward reef flats, both windward and leeward. Also taken on lagoon reef flats, on minor reef prominences in lagoons, and on coral masses in surge channels along the seaward reef edge. Lives at or near low tide line to depths of 10 feet. Commonly associated with species of *Turbo*, *Vasum*, and *Bursa*.

GEOGRAPHIC RANGE: Widespread and fairly common in Micronesia but not throughout the Indo-Pacific. Not found in Hawaii. US NM records are from southern Japan, the Ryukyu, Philippine, Mariana, Caroline, Marshall, Gilbert, Solomon, Loyalty and Fiji islands, Samoa, and New Caledonia.

Genus TROCHUS Linné, 1758

There are several closely related representatives of this genus in the Indo-Pacific. Extensive study, beyond the scope of this paper, is needed to clarify their systematic positions. As in other groups, the most widely accepted and generally understood names are recorded here.

*Trochus histrio histrio* Reeve, 1848.

Typically 1 to 1.25 inches long, with a red columellar blotch and a spiral ridge within the columella. Characterized by beading of unequal size, the bead rows immediately above the sutures tending to be larger than the beading on the rest of the shell. The beading in general is finer than that of *T. histrio intextus*.<sup>2</sup>

<sup>2</sup> Unlike *T. histrio histrio*, the Hawaiian form of *Trochus*, *T. histrio intextus* Kiener (1850), possesses evenly spaced, spiral rows of uniformly sized beading over the entire shell. It lives among rocks of seaward reef flats. Morrison found specimens living on the concrete walls at Coconut Island, Kaneohe Bay, Oahu. Apparently it is limited to the Hawaiian Islands.

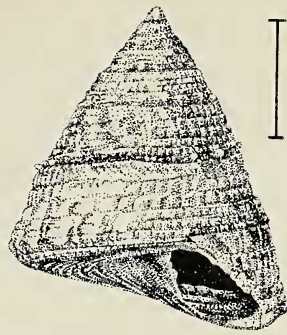


FIG. 1. *Trochus histrio histrio* Reeve. Bikini Atoll, Marshall Islands (USNM 579805).

Commonly found on small reefs on lagoon floors in water 1 to 20 feet deep. Also lives on rocks in the lower intertidal zone of both windward and leeward ocean reef flats, ordinarily on the reef edge.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM collections are from the south China coast, southern Japan, and the Ryukyu, Philippine, Mariana, Palau, Caroline, Marshall, Gilbert, Ellice, and Line (Palmyra) islands. A common Micronesian species, not found in Hawaii.

*Trochus maculatus* Linné, 1758.

Hirase and Taki (1951) pl. 65, fig. 1.

Characteristically 2 to 2.5 inches long and marked from apex to base with discontinuous longitudinal red streaks. *T. maculatus* lacks the columellar ridge and red columellar blotch of *T. histrio*.

Lives on rocks at the outer edge of both seaward and lagoon reef flats.

GEOGRAPHIC RANGE: USNM collections are from India, the Gulf of Siam, south China coast, southern Japan, from the Ryukyu, Palau, and Philippine islands, and from Arno Atoll. *T. maculatus* is rare in Micronesia, and absent from Hawaii, but it is fairly common in southern Japan and in the Ryukyu and Palau islands.

*Trochus niloticus* Linné, 1767.

Hirase and Taki (1951) pl. 65, fig. 6.

The largest of the Trochidae, commonly with a basal diameter of 4 or 5 inches and a length of 3 to 4 inches. White with reddish, wavy, interrupted longitudinal streaks.

Ordinarily lives in shallow water on rocks and in crevices near the outer edge of both seaward and lagoon reef flats. Also found on rocky bottoms, both ocean and lagoon, to depths of 40 or 50 feet.

*T. niloticus* is the object of extensive fisheries in Australia, Japan, the Palau, Philippine, Andaman, and Nicobar islands, because its shell is commercially valuable for manufacturing buttons and jewelry and for inlaying and similar ornamental work. A detailed account of its life history, habits, and habitat is presented by Rao (1939). The commercial use of the shell in the Philippines is discussed by Talavera and Faustino (1931).

**GEOGRAPHIC RANGE:** USNM collections are from Mauritius eastward to Fiji, and from southern Japan south to New Guinea and New Caledonia. Reported from northern Australia but not from Hawaii. Colonies of *T. niloticus* have been introduced at Truk, Yap, the Palau and Marshall islands.

*Trochus ochroleucus* Gmelin, 1791.

Characteristically 1.25 to 1.5 inches long. Resembles *T. maculatus* and *T. bistrio* but may be recognized by its more massive shell, the short subsutural axial riblets on its body whorl, the raised spiral cord on its columella, and the absence of a red columellar blotch. Specimens are commonly encrusted with coralline algae, vermetids, and Foraminifera.

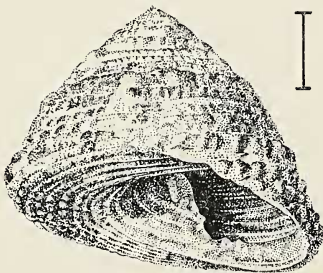


FIG. 2. *Trochus ochroleucus* Gmelin. Kikaigasima, Osumi, Japan (USNM 343138).

Lives under rocks and among coralline algal heads at the edge of reef flats, in the zone of breaking surf. Records in the recent Micronesian collections indicate that *T. ochroleucus* lives in greatest abundance on windward reefs, both ocean and lagoon, although a few specimens were taken from leeward ocean reefs. *T. ochroleucus* is invariably found below low tide line.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific. USNM collections are from southern Japan, the Ryukyu, Bonin, Mariana, Caroline, Admiralty, Marshall, Gilbert, Solomon, Loyalty, and Fiji islands, Samoa, Niuaufou, and New Guinea. Fairly common in Micronesia. Not found in Hawaii.

#### Family TURBINIDAE—Turban Shells

##### Genus TURBO Linné, 1758

*Turbo argyrostoma* Linné, 1758.

Hirase and Taki (1951) pl. 73, fig. 4.

Characteristically 1.75 to 3.5 inches long. Recognized by its papillose, brownish or greenish operculum and the low scaly spines on its spiral ribs.

*T. argyrostoma* lives in rock crevices on seaward reef flats, along the seaward reef edge, in rocky passes between reefs, and in crannies on minor reef prominences in lagoons. It invariably occurs below low tide line, commonly in several feet of water.

**GEOGRAPHIC RANGE:** USNM collections are from Aldabra Island and Mauritius in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands; and from southern Japan, the Ryukyu and Bonin islands south to New Guinea and New Caledonia. Reported to be common in Queensland, Australia. It is the most common *Turbo* in Micronesia.

A form or subspecies of *T. argyrostoma*, characterized by a tendency toward channelled sutures, swollen whorls, and a lack of spines, is common in Hawaii, although typical *T. argyrostoma* is not found there. This



form has been called *T. articulatus* Reeve and *T. intercostalis* Menke.

*Turbo petholatus* Linné, 1758 (syn. *variabilis* Reeve, 1842; *militaris* Reeve, 1848).

Hirase and Taki (1951) pl. 73, fig. 1.

Characteristically 1.25 to 3 inches long with a polished shell strikingly marked with reddish-brown and fawn color.

The recent Micronesian collections contain only two specimens of *T. petholatus*. Both were found living on small reefs on the sandy lagoon shelf at Ifaluk. These particular reefs are never exposed, even during spring tides, and are ordinarily covered by 3 to 5 feet of water at low tide.

GEOGRAPHIC RANGE: USNM collections are from Mauritius in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands, and from southern Japan south to northern Australia and New Caledonia. Uncommon in Micronesia. Not found in Hawaii.

*Turbo setosus* Gmelin, 1791 (syn. *stenogyrus* Fischer, 1873).

Hirase and Taki (1951) pl. 73, fig. 5 [as *T. stenogyrus* Fischer]; Morris (1952) p. 164, pl. 35, fig. 11.

Characteristically 1.5 to 3.75 inches long. Distinguished from *T. argyrostoma* by its typically smooth, white operculum, its lower spire, and the absence of spines on its spiral ribs.

*T. setosus* apparently lives almost exclusively on the seaward edge of windward ocean reef flats, embedded in rock crevices. It is also reported from the edge of the windward lagoon reef flat at Bikini where the lagoon is broad enough to allow the development of a strong surf along the windward lagoon shore.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM records are from the Mariana, Marshall, Gilbert, Caroline, Solomon, Fiji, Samoan, Niaufofu, Cook, Society, and Tuamotu islands, and from New Guinea. Reported from the Ryukvus, Philippines, For-

mosa, and Queensland, Australia. Common in Micronesia but not as abundant there as *T. argyrostoma*. Absent from Hawaii.

#### Family NERITIDAE—Nerites

##### Genus NERITA Linné, 1758

*Nerita albicilla* Linné, 1758.

Hirase and Taki (1951) pl. 75, fig. 8; Morris (1952) p. 166, pl. 36, fig. 15; Kira (1955) pl. 11, fig. 15.

Characteristically about one inch long with rows of tubercles on the columellar deck.

*N. albicilla* is a solitary species found on or under rocks of seaward reef flats or along rocky ocean shores. None of the specimens studied were taken along lagoon shores. *N. albicilla* apparently lives near low tide line, farther from shore than *N. plicata*, *N. polita*, or *N. undata*.

GEOGRAPHIC RANGE: USNM collections are from the entire east African coast, including the Red Sea, eastward through the Indian and Pacific oceans to the Tuamotu Islands, and from southern Japan and Hawaii south to New South Wales, Australia. An uncommon species in Micronesia.

*Nerita plicata* Linné, 1758.

Hirase and Taki (1951) pl. 75, fig. 14; Tinker (1952) p. 198, figs. on p. 199; Kira (1955) pl. 11, fig. 17.

Characteristically about one inch long with conspicuous raised spiral ribs, a wrinkled columellar deck, and four strong columellar teeth.

*N. plicata* is typically found living in groups on and under rocks at and above high tide line along both ocean and lagoon shores. Although it is out of water for long periods, it apparently avoids desiccation by remaining in rock crevices during the day. At night it creeps about the rocks, presumably feeding upon surface algae. It is also frequently active on rainy or overcast days. *N. plicata* is commonly associated with species of *Littorina* and *Melampus*.

GEOGRAPHIC RANGE: USNM collections are from the entire east African coast, eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands, to Clipperton Island in the eastern Pacific, and from southern Japan and Hawaii south to Queensland, Australia. *N. plicata* is very common throughout the Indo-Pacific.

*Nerita polita* Linné, 1758.

Hirase and Taki (1951) pl. 75, fig. 13;

Morris (1952) p. 165, pl. 36, fig. 16;

Kira (1955) pl. 11, fig. 19.

Characteristically about one and one-half inches long, with a smooth, polished shell mottled with grey, white, and black.

*N. polita* lives among rocks at and above, but generally not below, high tide line along both ocean and lagoon shores. During the day it remains buried about an inch deep in sand between the rocks. At night it browses on the algae-covered rock surfaces.

GEOGRAPHIC RANGE: USNM collections are from the entire east African coast, including the Red Sea, eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to the East Indies, New Guinea, and New Caledonia. Reported from northern Australia. Very common throughout the Indo-Pacific.

*Nerita signata* Lamarck, 1822 (syn. *reticulata* Karsten, 1789, nonbinom.).

Characteristically 1 to 1.25 inches long, with raised spiral ribs crossed by numerous fine, wavy crenulations.

The recent Micronesian collections contain only one individual, found among intertidal rocks of the beach at Tomil Harbor, Yap.

GEOGRAPHIC RANGE: Apparently limited to the Pacific, uncommon in Micronesia, and absent from Hawaii. USNM records are from the Ryukyu Islands, Gulf of Siam, Borneo, and the Philippine, Caroline, Fiji, and Gilbert islands.

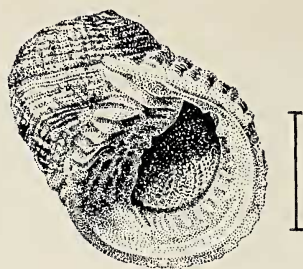


FIG. 3. *Nerita signata* Lamarck. Yap Island, western Carolines (USNM 614206).

*Nerita undata* Linné, 1758.

Characteristically 1 to 1.5 inches long, blackish with a white columella and aperture, and bearing numerous spiral incised grooves.

Specimens in the collections studied were found on and under rocks at or near high tide line along the tidal flats and rocky beach



FIG. 4. *Nerita undata* Linné. Yap Island, western Carolines (USNM 614207).

at Tomil Harbor, Yap. Morrison reports *N. undata* from the mangrove swamps along Bay of Islands, Fiji, living in the mud or on the mangrove roots together with *Littorina scabra*.

**GEOGRAPHIC RANGE:** Widespread but apparently limited to the muddy shores of high volcanic islands and continental coasts and not found along the shores of atolls. USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Tuamotu Islands, and from the Ryukyu Islands south to northern Australia and New Zealand. Uncommon in Micronesia and not reported at all from the Marshall, Mariana, Gilbert, or Hawaiian islands.

Family LITTORINIDAE—Periwinkles

Genus LITTORINA Ferussac, 1821

*Littorina coccinea* (Gmelin, 1791) (syn. *obesa* Sowerby, 1832).

Characteristically 0.5 to slightly more than 1 inch long with a red-brown columella and aperture and without spiral lines within the aperture. Exterior light pink or purplish and entirely lacking additional color markings.

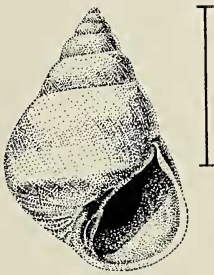


FIG. 5. *Littorina coccinea* (Gmelin). Bikini Atoll, Marshall Islands (USNM 585874).

Lives at and above high tide line along rocky shores, both ocean and lagoon, commonly in groups in rock crevices. Frequently found in the zone barely wet by spray at high tide and even in areas wet only by rain. Morrison reports having found this species living as far as 50 to 100 yards inland. *L.*

*coccinea* is characteristically active at night or on overcast days.

**GEOGRAPHIC RANGE:** USNM collections are from Cocos-Keeling Atoll in the Indian Ocean eastward to the Hawaiian and Society islands, and from southern Japan south through Micronesia to Fiji. Reported from northern Australia. *L. coccinea* is the most common littorine in Micronesia.

*Littorina pintado* (Wood, 1828).

Hirase and Taki (1951) pl. 79, fig. 12;

Tinker (1952) p. 174, 2 figs. on p. 175 (poor).

Characteristically 0.37 to slightly less than 1 inch long with a dark brown columella and conspicuous dark brown spiral lines within the aperture. Exterior purplish gray and covered with minute streaks or dots.

Habitat similar to that of *L. coccinea*, although *L. pintado* apparently does not live as far above high tide line as does *L. coccinea*. According to Morrison and Cloud, the two species overlap in the upper spray zone, *L. coccinea* extending upward and *L. pintado* extending down. Like most littorines, *L. pintado* can survive long periods of exposure. Edmondson (1946) reports an individual which, after being out of water for nearly a year, revived in a few minutes upon being replaced in sea water.

**GEOGRAPHIC RANGE:** Uncommon in Micronesia, and apparently limited in its range to the northern Pacific islands. USNM collections are from southern Japan, the Ryukyus, Bonins, Philippines (northern group only), Marianas, Marshalls, Johnston Island, and Hawaii. Reported from Formosa.

*Littorina scabra* (Linné, 1758).

Hirase and Taki (1951) pl. 79, fig. 13;

Tinker (1952) p. 174, 3 figs. on p. 175.

Characteristically 0.5 to slightly more than 1.5 inches long and marked on all whorls with broad, brown zig-zag streaks.

Lives at and above high tide line along muddy mangrove shores, either on the man-

grove roots or in the mud, and also among shoreline rocks. Commonly associated with *Nerita undata*.

**GEOGRAPHIC RANGE:** Apparently more abundant along continental and high-island shores than on atolls. USNM collections are distributed from East Africa through the Indian and Pacific oceans to Hawaii and Tahiti, and from the Philippines and Marianas south to northern Australia. Reported from the Ryukyu Islands. Uncommon in Micronesia.

*Littorina undulata* Gray, 1839.

Hirase and Taki (1951) pl. 79, fig. 11;  
Tinker (1952) p. 174, 2 figs. on p. 175.

Characteristically 0.37 to 0.87 inches long with a purplish columella. Exterior variously marked with brown zig-zag streaks, dots, or indefinite color markings.

Lives near and above high tide line along rocky shores, both ocean and lagoon. Groups of *L. undulata* commonly occur in rock crevices.

**GEOGRAPHIC RANGE:** USNM collections are from the coast of India, Ceylon, and Cocos-Keeling Atoll eastward to the Line Islands and Samoa, and from southern Japan south to New Guinea and New Caledonia. Reported from Hawaii but not from Australia. Fairly common in Micronesia.

#### Family CERITHIIDAE—Ceriths

Genus RHINOCLAVIS Swainson, 1840

*Rhinoclavis aluco* (Linné, 1758).

Hirase and Taki (1951) pl. 83, fig. 7.

Characteristically 2 to 2.5 inches long.

Ordinarily lives on lagoon shelves, buried in sand among roots of turtle grass and other seaweeds, or in sand pockets on or among small lagoon reefs. Invariably found below low tide line, commonly at depths of a few feet.

**GEOGRAPHIC RANGE:** Apparently limited to the western and west central Pacific, uncommon in Micronesia, and absent from Hawaii. USNM records are from the Ryukyu, Philip-

pine, Palau, Caroline, Solomon, Samoan, and Fiji islands, the Sulu Archipelago, the Schouten Islands off New Guinea, and from northern Australia and New Caledonia.

*Rhinoclavis aspera* (Linné, 1758).

Hirase and Taki (1951) pl. 83, fig. 1.

Characteristically 1 to 2 inches long.

Ordinarily lives in sand on lagoon floors or off the edge of seaward reefs. Also found in sand pockets on seaward reef flats and on small lagoon reefs. Invariably occurs below low tide line, usually at depths of 3 to 15 fathoms.

**GEOGRAPHIC RANGE:** USNM collections are from Mauritius and Ceylon eastward throughout the Indian and Pacific oceans to the Cook Islands, and from southern Japan and Palmyra south to northern Australia. Apparently not found in Hawaii, but fairly common in Micronesia.

*Rhinoclavis sinensis* (Gmelin, 1791) (syn. *obeliscus* Bruguière, 1792).

Hirase and Taki (1951) pl. 83, fig. 4; Tinker (1952) p. 166, 3 figs. on p. 167 [as *C. obeliscus* Bruguière].

Characteristically 1.25 to 2 inches long.

Lives among sand and rocks on seaward reef flats both windward and leeward, and on small reefs of sandy lagoon shelves. Ordinarily found near, or a few feet below, low tide line.

**GEOGRAPHIC RANGE:** According to USNM records, distributed along the entire east African coast from Natal, Durban, South Africa, to the Red Sea, eastward throughout the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia. A fairly common species in Micronesia.

*Rhinoclavis tenuisculpta* (Reeve, 1866).

Characteristically 1 to 1.75 inches long and sculptured with nodulose spiral cords, of which 4 or 5 may be heavier than the others. Shell white and typically mottled with brown,

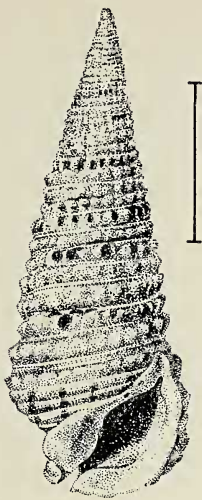


FIG. 6. *Rhinoclavis tenuisculpta* (Reeve). Bikini Atoll, Marshall Islands (USNM 580526).

although entirely white specimens have been found. Aperture white.

Found living in sand on lagoon floors and off the edge of seaward reefs, at depths of 10 to 500 feet.

**GEOGRAPHIC RANGE:** USNM collections are distributed from Mauritius eastward throughout the Indian and Pacific oceans to Midway Island and the Tuamotus, and from southern Japan south to northern Australia. Fairly common in Micronesia, but apparently replaced in Hawaii by *R. granifera* Pease.

*Rhinoclavis vertagus* (Linné, 1767).

Hirase and Taki (1951) pl. 83, fig. 2.

Characteristically 1.5 to 2.5 inches long.

The recent Micronesian collections contain only one specimen, found living among intertidal rocks on the beach at Tomil Harbor, Yap.

**GEOGRAPHIC RANGE:** USNM records are distributed from Mauritius and Ceylon eastward through the Indian and Pacific oceans only as far as the Caroline and Solomon islands, and from the Ryukyu Islands south to northern Australia. An uncommon species in Micronesia. Not found in Hawaii.

Genus *CERITHIUM* Bruguière, 1789

*Cerithium alveolus* Hombron and Jacquinot, 1841 (syn. *C. piperitum* Sowerby, 1855).

Characteristically less than one-half inch long. Shell white, covered with spiral ridges of varying depth and with many fine, brown spots. Columella violet. *C. alveolus* superficially resembles *C. sejunctum*, but it is more slender, its brown markings are finer, its spiral ridges are not nodose, and its outer lip is not violet.

The many specimens from the Marshall Islands in the collections studied indicate that *C. alveolus* is abundant on windward ocean reef flats where it lives in sandy depressions among rocks and in rocky tide pools. The collections also include several specimens from the sandy lagoon bottom of Tanapag Harbor, Saipan, found among small reefs at depths of 10 to 15 feet.

**GEOGRAPHIC RANGE:** USNM records are from the Mariana and Marshall islands only. Reported from the Ryukyu Islands and Formosa, but not from Hawaii. Probably more widespread but rarely noticed because of its small size. Apparently fairly common in Micronesia.



FIG. 7. *Cerithium alveolus* Hombron and Jacquinot. Bikini Atoll, Marshall Islands (USNM 583953).

*Cerithium columna* Sowerby, 1855 (syn. *echinatum* Kiener, 1841; not Lamarck, 1822).

Tinker (1952) p. 166, 3 figs. on p. 167.

Characteristically 0.75 to 1.5 inches long. Shell whitish. Aperture white. Spiral ridges between the nodes commonly dark brown.

Ordinarily found buried in sand near and below low tide line. Most of the specimens in the recent Micronesian collections were

living in sand pockets on windward ocean reef flats. USNM specimens from Hawaii, however, were dredged from depths of 30 to 300 feet off Honolulu Harbor and Waikiki Beach. *C. columna* is also common in the lagoon at Pulo Panjang, Cocos-Keeling Atoll (Abbott, 1950), and on the reefs of northern Australia (Allan, 1950).

**GEOGRAPHIC RANGE:** USNM collections are distributed from Mauritius eastward through the Indian and Pacific oceans to the Hawaiian and Tuamotu islands, and from southern Japan south to northern Australia. A common species in Micronesia.

*Cerithium morus* Bruguière, 1792.

Characteristically about one inch long, rather inflated, and strongly granulose. Shell dark brown or black. Aperture white. The recent Micronesian collections contain only four specimens, all of which were found among intertidal rocks at Tomil Harbor beach, Yap.

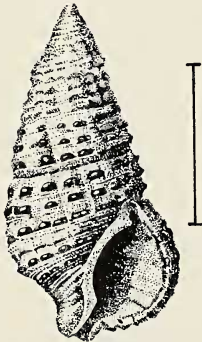


FIG. 8. *Cerithium morus* Bruguière. Guam, Mariana Islands (USNM 585837).

**GEOGRAPHIC RANGE:** USNM collections are distributed from Mauritius and the east coast of India eastward through the Indian and Pacific oceans to the Hawaiian and Tuamotu islands, and from the Philippine and Mariana islands south to Borneo, the Solomon Islands, and Fiji. Not reported from Australia or southern Japan. Uncommon in Micronesia.

*Cerithium nassoides* Sowerby, 1855 (syn. *maculosum* Mighels, 1845).

Tinker (1952) p. 170, 2 figs. on p. 171 [as *C. maculosum* Mighels].

Characteristically less than one-half inch long and white with scattered brown spots of varying size.

Only one specimen in the recent Micronesian collections was taken alive. It was found in a sand pocket among small reefs at a depth of 10 to 20 feet in the lagoon entrance west of Saipan. Dead specimens were taken from seaward reef flats at Eniwetok and Rongelap.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific and fairly common in Micronesia. USNM records are from the Mariana, Marshall, Loyalty, Tuamotu, and Hawaiian islands only. Reported from southern Japan but not from Australia.

*Cerithium nodulosum* Bruguière, 1792.

Hirase and Taki (1951) pl. 83, fig. 8; Kira (1955) pl. 12, fig. 22.

The largest Indo-Pacific *Cerithium*, characteristically 3 to 4.5 inches long.

Lives among sand and rocks on seaward reef flats, ordinarily just shoreward of the reef edge. Also found in channels between reef segments and on small lagoon reefs. Invariably occurs below low tide line, commonly in a few feet of water but occasionally at depths of 10 feet or more.

**GEOGRAPHIC RANGE:** USNM records are distributed from Mauritius eastward throughout the Indian and Pacific oceans to the Society Islands, and from the Ryukyu, Mariana, and Marshall islands south to New Caledonia. Reported from northern Australia but not from southern Japan or Hawaii. Fairly common in Micronesia.

*Cerithium salebrosus* Sowerby, 1855.

Characteristically one inch or less long, slender and sharply sculptured with strong axial ribs crossed by spiral cords. Shell and aperture white. Ordinarily lives on sandy lagoon slopes and floors at depths of about 5 to 200 feet. Occasionally taken on small reefs of sandy lagoon. Apparently not found on seaward reef flats or above low tide line.



FIG. 9. *Cerithium salebrosum* Sowerby. Ifaluk Atoll, Caroline Islands (USNM 614197).

GEOGRAPHIC RANGE: USNM records are exclusively from atolls in the Caroline, Marshall, and Gilbert islands. Appears to be uncommon in Micronesia, and absent from Hawaii, but is probably more widespread than the records indicate, being rarely noted because of its small size and relatively deep water habitat.

*Cerithium sejunctum* Iredale, 1929 (syn. *variegatum* Quoy and Gaimard, 1834, preocc.).



FIG. 10. *Cerithium sejunctum* Iredale. Bikini Atoll, Marshall Islands (USNM 580070).

Characteristically about one-half inch or less in length and with granose spiral ridges. Shell whitish, mottled with varying shades of brown. Aperture typically pale violet, particularly on the columella and outer lip. Ordinarily found buried in sand near or a few feet below low tide line. Most of the specimens in the recent Micronesian collections were living in sand among rocks and in rocky tide pools on windward ocean reef flats. Abbott (1950) reports *C. sejunctum* to be "plentiful in the lagoon in shallow, weedy water" at Cocos-Keeling Atoll.

GEOGRAPHIC RANGE: USNM records are from Cocos-Keeling Atoll in the Indian Ocean and from the Marshall, Gilbert, Phoe-

nix, and Fiji islands in the Pacific. Reported from southern Japan and Formosa, but not from Hawaii. Common in Micronesia.

*Cerithium tuberculiferum* Pease, 1869.

Tinker (1952) p. 166, 2 figs. on p. 167 [as *C. echinatum* Lamarck].

Characteristically 1.5 to 2.25 inches long and sculptured with spiral, tuberculated cords which are spinose around the periphery of each whorl. Shell whitish with irregular brown markings. Aperture white.

Found buried in sand among rocks and coral patches below low tide line on seaward and lagoon reef flats and at depths of a few feet in channels between reefs.

GEOGRAPHIC RANGE: USNM records are from the Philippine, Mariana, Marshall, Gilbert, Loyalty, Samoan, Society, Tuamotu, Phoenix, Line, and Hawaiian islands. Not reported from southern Japan or Australia, but fairly common in Micronesia.

#### Family HIPPONICIDAE—Hoof Shells

Genus HIPPONIX DeFrance, 1819

Subgenus SABIA Gray, 1847

*Hipponix (Sabia) conicus* (Schumacher, 1817).

Characteristically 0.25 to 0.75 inch long, with irregular radial ribs, and white with a dark brown muscle scar inside the shell. Commonly lives below low tide line on seaward reef flats, attached to the shells of other gastropods, typically around the aperture. A species with similar attachment habits (*H. australis*) has been observed by Risbec (Yonge, 1953) to feed upon the fecal pellets of the host. Specimens in the present collections were found on *Turbo setosus*, etc. Morrison and Cloud report a possibly unrecorded species of *Hipponix* which they found in Micronesia attached to corals, algae, or rocks; they believe it feeds on detritus, as does the common California *H. antiquatus* (Yonge, 1953). Specimens in the present collections were found on *Turbo setosus* and *T. argrostomus*, *Vasum turbinellae* and *V. ceramicum*, *Thais ar-*

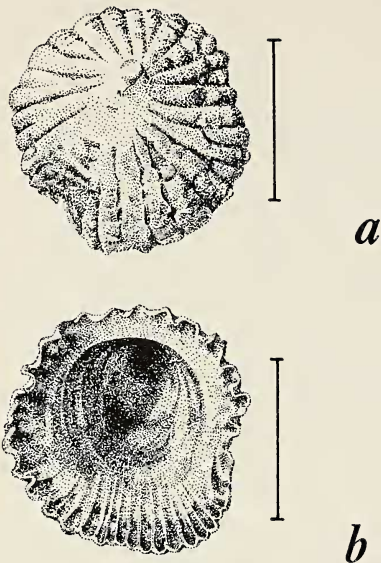


FIG. 11. *Hipponix (Sabia) conicus* (Schumacher). *a*, exterior view of specimen from Pavuvu, Solomon Islands (USNM 488419); *b*, interior view of specimen from Ifaluk Atoll, Caroline Islands (USNM 614198).

*migera*, *Drupa morum* and *D. rubusidaeus*, *Morula elata*, *Cerithium tuberculatum* and *C. nodulosum*, and on *Conus distans*, *C. flavidus*, *C. lividus*, and *C. aulicus*. A species with similar attachment habits (*H. australis*) has been observed by Risbec (Yonge, 1953) to feed upon the faecal pellets of the host shell. Micronesian specimens of *Hipponix* found attached to corals, algae, or rocks (Morrison, Cloud) probably feed on detritus, as does the common Californian *H. antiquatus* (Yonge, 1953), and may represent an unrecorded species.

GEOGRAPHIC RANGE: USNM records are from East Africa throughout the Indian and Pacific oceans to the Hawaiian, Tuamotu, and Society islands, and from southern Japan south to northern Australia and New Caledonia. Common in Micronesia.

#### Genus CHEILEA Modeer, 1793

*Cheilea equestris* (Linné, 1758).

Tinker (1952) p. 182, fig. on p. 183 (as *C. dillwyni* (Gray) ); Kira (1955) pl. 13, fig. 9 (as *C. scutulum* (Reeve) ).

Characteristically 1.25 to 1.5 inches long, yellowish white externally and polished white

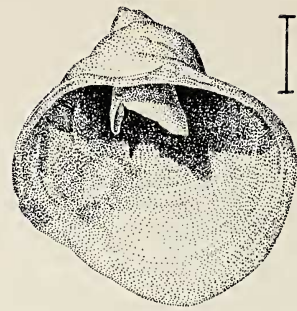


FIG. 12. *Cheilea equestris* (Linné). Onotoa Atoll, Gilbert Islands (USNM 607768).

within. Lives among rocks on both seaward and lagoon reef flats, ordinarily a few feet below low tide line.

GEOGRAPHIC RANGE: USNM collections are from the Caroline, Marshall and Gilbert islands and indicate the species to be fairly common in Micronesia. It is reported from southern Japan and Hawaii.

#### Family STROMBIDAE—Conch Shells

##### Genus STROMBUS Linné, 1758

*Strombus dentatus* Linné, 1758 (syn. *tridentatus* Gmelin, 1791).

Tinker (1952) p. 164, 3 figs. on p. 165 [as *S. tridentatus* Lamarck]; Kira (1955) pl. 15, fig. 3 [as *Canarium tridentatum* (Gmelin) ].

Characteristically 1.5 to 2 inches long. Shell whitish, mottled with yellow or brown, and with transverse raised ridges on all whorls. Interior of aperture dark orange-brown. Outer lip ridged internally, flared, and bearing several, large white teeth on its outer edge.

Only one specimen in the recent Micronesian collections was taken alive, from under rocks in 3 to 4 feet of water on the sandy lagoon shelf at Ifaluk. Several beach-worn specimens were collected at Eniwetok and Bikini, among rocks on both seaward and lagoon reef flats.

GEOGRAPHIC RANGE: USNM collections are from East Africa, the Red Sea, and Mauritius eastward through the Pacific to the Tuamotu Islands, and from southern Japan and



Hawaii south to New Guinea, the Solomon Islands and New Caledonia. Uncommon in Micronesia.

*Strombus fragilis* (Röding, 1798) (syn. *samar* Dillwyn, 1817; *bulbulus* Sowerby, 1842).

Characteristically 1.5 to 2 inches long. Shell whitish and mottled with orange or brown. Columella and outer lip reddish-brown. Whorls smooth, lacking the raised ridges of *S. dentatus*. Outer lip flared and ridged internally but without the toothed edge of *S. dentatus*.

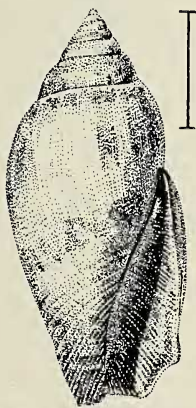


FIG. 13. *Strombus fragilis* (Röding). Guam, Mariana Islands (USNM 533081).

Apparently lives below low tide line in both lagoon and offshore ocean waters. The recent Micronesian collections include only broken specimens dredged from a depth of 150 to 200 feet off the sandy floor of Bikini lagoon, and worn specimens from four feet of water at Yap and from the shore of Mañagaha Island, Saipan.

**GEOGRAPHIC RANGE:** USNM records are from the Philippine, Mariana, Marshall, Caroline, Samoan, and Fiji islands only. These collections indicate that *S. fragilis* is uncommon in Micronesia and absent from Hawaii.

*Strombus gibberulus* Linné, 1758.

Kira (1955) pl. 15, fig. 7.

Characteristically 1 to 1.5 inches long and porcelain white with brown markings and a purple or pink aperture.

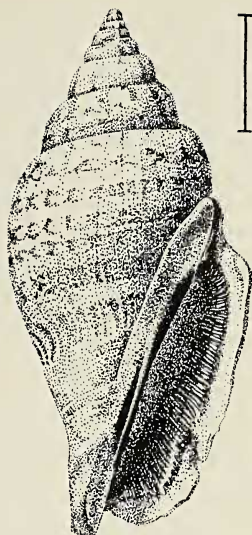


FIG. 14. *Strombus gibberulus* Linné. Yap, Caroline Islands (USNM 614208).

Plentiful in Micronesia on sandy lagoon flats, which are barely exposed at low tide, and on sandy lagoon floors to depths of 60 feet. Also found in sandy depressions on lagoon reef flats. Abbott (1950) reports that *S. gibberulus* is "fairly abundant" on the outer beaches of Cocos-Keeling Atoll. Abbott (1949) also reports the occurrence of thousands of individuals on the sand-mud flats at Guam and describes the habits of this species.

**GEOGRAPHIC RANGE:** USNM collections are from the entire east African coast and the Red Sea eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from the Ryukyu and Hawaiian islands south to Queensland, Australia, and New Caledonia. Common in Micronesia.

*Strombus lentiginosus* Linné, 1758.

Hirase and Taki (1951) pl. 86, fig. 4; Kira (1955) pl. 16, fig. 8.

Characteristically about three inches long with a silvery pink aperture.

Ordinarily found buried in sand at depths of 4 to 12 feet in quiet waters. Specimens in the recent Micronesian collections were taken on the sandy lagoon shelf at Rongelap and Ifaluk and from a protected channel at Ifaluk.

Abbott (1950) reports that *S. lentiginosus* occurs on the outer beach at Cocos-Keeling Atoll.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to Samoa, and from the Ryukyu, Mariana, and Marshall islands south to New Guinea and New Caledonia. Reported from the Great Barrier Reef, Australia, but not from Hawaii. Common in Micronesia.

*Strombus lubuanus* Linné, 1758.

Hirase and Taki (1951) pl. 86, fig. 14;

Kira (1955) pl. 15, fig. 8.

Characteristically about two inches long with a bright orange-red aperture and black parietal wall.

Lives in sand and coral rubble on lagoon shelves at depths of 2 to 12 feet.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and the Persian Gulf eastward through the Indian and Pacific oceans to the Society Islands, and from southern Japan, the Mariana, and Line islands south to New Caledonia and New South Wales, Australia. The National Museum has specimens of *S. lubuanus* from Palmyra, but none from Hawaii. The species is fairly common in Micronesia.

*Strombus maculatus* Sowerby, 1842.

Tinker (1952) p. 164, 3 figs. on p. 165;

Morris (1952) p. 178, pl. 37, fig. 18, col. pl. 8, fig. 13.

Characteristically 0.75 to 1 inch long and whitish with yellowish-brown markings and a white aperture.

Found in sandy gravel between the rocks of seaward reef flats.

**GEOGRAPHIC RANGE:** USNM records are from the Mariana, Caroline, Marshall, Gilbert, Phoenix, Line (Palmyra), Hawaiian, Cook, and Tuamotu islands, and from Easter Island. Uncommon in Micronesia, although abundant in Hawaii.

*Strombus mutabilis* Swainson, 1821 (syn. *floridus* Lamarck, 1822).

Characteristically slightly more than one inch long and variable in color. Typically whitish with brown markings and a flesh-colored aperture.

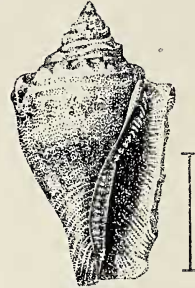


FIG. 15. *Strombus mutabilis* Swainson. Saipan, Mariana Islands (USNM 607947).

Ordinarily lives buried in the sand of lagoon shelves and slopes, among seaweed, from a few feet below low tide line to depths of 15 feet. Also found buried in sand pockets on small lagoon reefs and on seaward reef flats. At Ifaluk, individuals were found in the sandy-muddy sediments of the lagoon shelf among turtle grass roots in 2 to 6 feet of water, in the sandy lagoon floor among algae (*Halimeda* sp.) at depths of 10 to 15 feet, and in sand on lagoon small reefs. At Bikini and Eniwetok specimens were collected from sand on the shallow seaward reef flats. Specimens were also found at Saipan buried among seaweed on the sandy lagoon bottom of Tanapag Harbor at depths of 5 to 15 feet.

**GEOGRAPHIC RANGE:** USNM collections are from the entire east African coast and the Red Sea eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan, the Mariana and Marshall islands, south to northern Australia and New Caledonia. *S. mutabilis* is common in Micronesia, but apparently does not reach Hawaii, where the closely related *S. maculatus* is abundant.

Genus LAMBIS Röding, 1798  
(Syn. PTEROCERA Lamarck, 1799)

*Lambis chiragra* (Linné, 1758).

Hirase and Taki (1951) pl. 88, fig. 2; Kira (1955) pl. 16, fig. 12.

Characteristically 8 to 10 inches long, with a wrinkled, orange-colored aperture and columella.

Lives on seaward reef flats, in sand between rocks and coral heads, and in tide pools. Also found among masses of coral (*Heliopora*) in channels between seaward reefs in 8 to 10 feet of water. Invariably found below low tide line.

GEOGRAPHIC RANGE: USNM collections are from Zanzibar on the east African coast eastward throughout the Indian and Pacific oceans to the Marshall and Gilbert islands, and from southern Japan and the Mariana Islands south to northern Australia and New Caledonia. A common *Lambis* in Micronesia, but not reported from Hawaii.

*Lambis lambis* (Linné, 1758).

Hirase and Taki (1951) pl. 87, fig. 1; Kira (1955) pl. 16, fig. 7.

Characteristically 6 to 8 inches long with slender, upward-curving apertural spines and a smooth, pinkish aperture.

Lives in sand on both seaward and lagoon reef flats, and on sandy lagoon floors, ranging from a few feet below low tide line to depths of 10 feet.

GEOGRAPHIC RANGE: USNM collections are from the east African coast eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan, the Mariana and Marshall islands south to northern Australia and New Caledonia. The most common Indo-Pacific *Lambis*, but not reported from Hawaii.

*Lambis truncata* (Humphrey, 1786) (syn. *bryonia* Gmelin, 1791).

Hirase and Taki (1951) pl. 87, fig. 2.

The largest species of *Lambis*, characteristically 10 to 15 inches long. A ponderous shell with a smooth, flesh-colored aperture.

Commonly found at depths of 15 to 30 feet off the edge of seaward reefs, in sand among coral boulders. Also lives on sandy lagoon shelves among seaweed or on minor reef prominences in 2 to 10 feet of water. Invariably occurs below low tide line. At Onotoa Cloud observed a group of individuals which appeared to be sedentary. They were partly buried in the sandy bottom; their shells were overgrown with coral-algal encrustations and with colonies of branching coral 5 to 7 inches high. An examination of their stomach contents indicated that they had ingested quantities of the sandy substrate, presumably for nourishment.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward throughout the Indian and Pacific oceans to the Fiji Islands, and from the Ryukyu, Mariana, and Marshall islands south to New Caledonia. Reported from northern Australia but not from Hawaii. Fairly abundant in Micronesia.

## Genus TEREBELLUM Lamarck, 1799

*Terebellum terebellum* (Linné, 1758) (syn. *subulatum* Lamarck, 1811).

Hirase and Taki (1951) pl. 89, fig. 1; Kira (1955) pl. 15, fig. 1.

Characteristically 2 to 3 inches long and whitish with light brown markings.

The recent Micronesian collections include several lots of this species dredged from depths of 90 to 200 feet on the sandy bottom of Bikini lagoon and from 6 feet of water in Tomil Harbor, Yap.

GEOGRAPHIC RANGE: There are no USNM records east of Micronesia. USNM collections are from Mauritius in the Indian Ocean eastward through the Pacific to Samoa, and from southern Japan, the Mariana and Marshall islands south to northern Australia and New Caledonia. This species is uncommon in Micronesia.

## Family NATICIDAE—Moon Shells

## Genus POLINICES Montfort, 1810

*Polinices mammilla* (Linné, 1758) (syn. *pyriformis* Récluz, 1844).

Hirase and Taki (1951) pl. 91, fig. 4 [as *P. pyriformis* Récluz]; Tinker (1952) p. 188, 3 figs. on p. 189; Morris (1952) p. 174, pl. 37, fig. 8 [as *P. pyriformis* Récluz]; Kira (1955) pl. 17, fig. 10 [as *P. pyriformis* (Récluz)].

Characteristically 1.25 to 2 inches long with an entirely white polished shell.

Although *P. mammilla* is common in Micronesia, only one specimen in the recent collections was taken alive. It was found at night by Cloud on the surface of sandy intertidal flats along the lagoon shore of Uliga Island, Majuro Atoll. Edmondson (1946) reports this species living in Hawaii at depths of a few fathoms and occasionally occurring on the reefs.

**GEOGRAPHIC RANGE:** USNM collections are from the entire east African coast from Natal, Durban, South Africa, to the Red Sea, eastward through the Indian and Pacific oceans to Samoa, and from southern Japan and Hawaii south to northeastern Australia and New Caledonia.

*Polinices melanostoma* (Gmelin, 1791) (syn. *opacus* Récluz, 1851).

Hirase and Taki (1951) pl. 91, fig. 1 [as *P. opacus* Récluz].

Characteristically 1.25 to 2 inches long, with a polished white shell and a dark brown inner lip.

Ordinarily found buried in the sand of lagoon shelves or in sand pockets on both seaward and lagoon reef flats, covered by several feet of water. Also lives in sand flats exposed at low tide. Presumably preys on pelecypods.

**GEOGRAPHIC RANGE:** USNM collections are distributed from East Africa and Mauritius through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Palmyra south to New Guinea and New Caledonia. Fairly common in Micronesia. Reported from Hawaii but not from Australia.

Genus NATICA Scopoli, 1777

*Natica marochiensis* (Gmelin, 1791).

Morris (1952) p. 174, pl. 37, fig. 5.

Characteristically about three-fourths inch long, with a smooth white calcareous operculum.

*N. marochiensis* lives on a sandy bottom, ordinarily in shallow water on lagoon shelves or in sand pockets on lagoon reef flats, but it also occurs in protected bays and harbors to depths as great as 50 feet. Typically, it remains buried in the sand during the day and emerges at night.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and the Red Sea eastward through the Indian and Pacific oceans to the Cook Islands, and from the Ryukyu and Hawaiian islands south to the Caroline Islands and Samoa. Not reported from Australia. Apparently uncommon in Micronesia, although common at Cocos-Keeling Atoll and in Hawaii.

*Natica onca* (Röding, 1798) (syn. *chinensis* Lamarck, 1816).

Hirase and Taki (1951) pl. 90, fig. 8; Kira (1955) pl. 17, fig. 4.

Characteristically 0.75 to 1 inch long with raised ridges on its white calcareous operculum. Resembles *N. violacea*, but its umbilicus is more open above and below than is that of *N. violacea*; its callus is white; and its color pattern is in discrete spots only, in rows.

The recent Micronesian collections include only one specimen, an empty shell from 4 feet of water at Yap.

**GEOGRAPHIC RANGE:** The only USNM specimens are from Okinawa, the Philippines, New Guinea, Admiralty and Solomon islands, New Caledonia, and from Vitilevu, Fiji. Reported from northern Australia, but not from Hawaii. These records indicate *N. onca* may be found only along the shores of high islands and continents but not near atolls. Apparently uncommon in Micronesia.

*Natica violacea* Sowerby, 1825.

Hirase and Taki (1951) pl. 90, fig. 9.

Characteristically 0.75 to 1 inch long. Resembles *N. onca* but, unlike that species, its umbilicus is rosy or violet and almost entirely covers the umbilicus; and the upper rows of color spots on its shell are larger than those of *N. onca*, and irregular, sometimes "literate" as in variations of *Conus ebraeus*.

Lives on sandy lagoon floors at depths of 90 to 150 feet. Drift specimens found on the seaward beaches of Bikini and Rongelap indicate the species may also live in deep water off the seaward reef edge.

GEOGRAPHIC RANGE: There are only 6 specimens in the USNM, from the northern Marshalls (Bikini and Rongelap atolls) and from Biak, Schouten Islands, Dutch New Guinea. *N. violacea* is rare in collections from Micronesia and the Indo-Pacific.

#### Family OVULIDAE—Egg Shells

##### Genus OVULA Bruguière, 1789

*Ovula ovum* (Linné, 1758).

Hirase and Taki (1951) pl. 94, fig. 18; Kira (1955) pl. 18, fig. 15.

The shell of *O. ovum* is globose and large, characteristically 3 to 5 inches long, polished white externally and deep orange-brown within the aperture. Its mantle, in striking contrast to the white shell, is ink black with only tiny white flecks.

This well-known Indo-Pacific species is prized by island natives for charms and ornaments but is seldom taken alive by collectors. A group of living specimens was found at a depth of about 12 feet in a protected embayment of the seaward reef front at the south side of Arno Atoll. The species was rare at Ifaluk; only one specimen was taken there, at a depth of 3 to 5 feet on the sandy lagoon shelf. At Arno, *O. ovum* was living on the compact surfaces of a dark brown soft coral which turns white where bruised; this association appeared to be a protective one for the mollusk, due to its dark mantle with white spots. However, in the case of the Ifaluk specimen of *O. ovum*, although it was living

on a soft coral, that soft coral was presumably a different species, being pale in color and thus affording no color protection for the mollusk. Apparently *O. ovum* is nutritionally dependent upon these alcyonarians.

GEOGRAPHIC RANGE: USNM collections are from East Africa and Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from the Ryukyu Islands south to New Guinea and New Caledonia. Reportedly abundant in northern Australia. Not found in Hawaii.

#### Family CYPRAEIDAE—Cowries

##### Genus CYPRAEA Linné, 1758

##### Subgenus CYPRAEA Linné, 1758

*Cypraea (Cypraea) carneola* Linné, 1758.

Tinker (1952) p. 142, 3 figs. on p. 143;

Morris (1952) p. 180, pl. 5, fig. 11.

Characteristically 1.5 to 2 inches long with bright purple teeth and interstices, four dark orange dorsal bands, and fawn-colored margins. Giant specimens, 2.5 to 3.5 inches long, occur in Hawaii.

Only one specimen in the recent Micronesian collections was taken alive. It was found on a small reef in 2 to 4 feet of water on the sandy lagoon shelf at Ifaluk. Abbott (1950) reports that *C. carneola* lives under rocks in shallow water on the reefs at Cocos-Keeling Atoll. In Hawaii, Ostergaard (1950) found this species in shallow water on seaward reef flats and Ingram (1947) observed giant individuals living in the same environment and copulating with normal-sized *C. carneola*. Like most cowries *C. carneola* is presumably nocturnal.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern Australia, Fiji, and Samoa. A fairly common species in Micronesia.

*Cypraea (Cypraea) lynx* Linné, 1758.

Tinker (1952) p. 148, 3 figs. on p. 149.

Characteristically about two inches long with many dorsal brownish spots and with bright orange interstices between its white teeth.

Ordinarily found in shallow water, under rocks and in tide pools, on seaward and lagoon reef flats. Also taken from minor reef prominences on sandy lagoon shelves at depths of a few feet.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia. Ingram (1947) reports *C. lynx* to be extremely rare in Hawaii, but it is fairly common in Micronesia.

*Cypraea (Cypraea) tigris* Linné, 1758.

Tinker (1952) p. 138, 4 figs. on p. 139;

Hirase and Taki (1951) pl. 92, fig. 6;

Kira (1955) pl. 20, figs. 16 and 17.

Characteristically 4 to 5 inches long; cream colored or yellowish-white, with large black spots.

*C. tigris* apparently lives under a variety of ecological conditions, and its size and color pattern differ from one geographic area to another. Records in the recent Micronesian collections indicate that the species most commonly occurs among rocks and in crevices of seaward reef flats, and at the seaward reef edge, near or a few feet below low tide line. Most of the specimens were taken on windward ocean reefs, but the species was also found on leeward ocean reefs, on lagoon reef flats, and on small reefs on lagoon floors. At Tanganyika, East Africa, Abbott (1951) observed a colony of 100 or more *C. tigris* living among eelgrass on a shallow sandy bottom. Few of these individuals were more than two and one-half inches long, and most of them possessed very dark coloring. Abbott also reports similar groups of small individuals from Okinawa, northeast Australia, and Halmahera, Dutch East Indies. In Hawaii, *C. tigris* lives at depths of 6 to 12 feet in offshore ocean

waters. Specimens of maximum size are found in Hawaii, but the species is rare there as compared with its occurrences to the south and west.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society Islands, and from the Ryukyu and Hawaiian islands south to northern Australia and New Caledonia. Reported from southern Japan. Common in Micronesia.

*Cypraea (Cypraea) vitellus* Linné, 1758.

Hirase and Taki (1951) pl. 92, fig. 4; Tinker

(1952) p. 142, 3 figs. on p. 143; Kira

(1955) pl. 20, fig. 7.

Characteristically about 2.5 to 3 inches long with variously sized white spots over its fawn-colored dorsum and with thin lines of sand colored specks on its margins.

Apparently lives on rocky surfaces or among rocks at depths of not more than a few feet on the outer flats of both seaward and lagoon reefs. In addition to several beach-worn shells, recent Micronesian collections include only three specimens that were taken alive; one in about three feet of water under rocks on the sandy lagoon shelf at Ifaluk, another on the seaward reef flat of windward Onotoa, and the third under near-shore rocks on the lagoon reef at Ine Village, Arno. Abbott (1950) reports *C. vitellus* living under boulders on the outer barrier reef at Cocos-Keeling Atoll. According to Allan (1950) this species is very common on rocky seaward reefs below low tide line in Australia.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern New South Wales, Australia, and New Caledonia. Uncommon in Micronesia.

Subgenus MAURITIA Troschel, 1863

*Cypraea (Mauritia) arabica* Linné, 1758.

Tinker (1952) p. 140, 3 figs. on p. 141.

Characteristically 2.5 to 3 inches long with reddish-brown teeth, a calloused spire, and numerous dark brown longitudinal hieroglyphic streaks over its dorsum.

*C. arabica* is ordinarily collected among rocks in shallow water on both seaward and lagoon reef flats. The recent Micronesian collections include two specimens that were taken alive, both from seaward reef flats at Ifaluk; one on the outer reef flat just shoreward of the reef edge, the other in a tide pool on the inner reef flat. Hiatt reports *C. arabica* to be the most common *Cypraea* on the shoreward portion of the lagoon reef flat at Ine Village, Arno.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and the coast of India eastward through the Indian and Pacific oceans to the Society Islands, and from the Ryukyu and Line islands south to northern New South Wales, Australia, and New Caledonia. Reported from southern Japan but not from Hawaii. Common in Micronesia.

*Cypraea (Mauritia) depressa* Gray, 1824.

Characteristically 1.5 to 2 inches long. Like *C. maculifera*, this species has brown dorsal reticulations and brown teeth, but it lacks a brown splotch on its ventral columellar surface.

*C. depressa* apparently lives under rocks on windward and leeward ocean reef flats, commonly just shoreward of the reef edge. Although a common species in Micronesia, it is seldom collected alive.

**GEOGRAPHIC RANGE:** USNM records are from Cocos-Keeling Atoll in the Indian Ocean, and from the Palau, Mariana, Caroline, Marshall, Gilbert, Phoenix, Line, Samoan, Cook, Society, and Tuamotu islands. Reported from the Ryukyu Islands, but not from Hawaii. *C. depressa* also ranges far into the eastern Pacific, occurring at Clipperton Island (Hertlein and Emerson, 1953) and at Cocos and the Galapagos islands (Ingram, 1951), but it is not found on the west coast of the Americas.

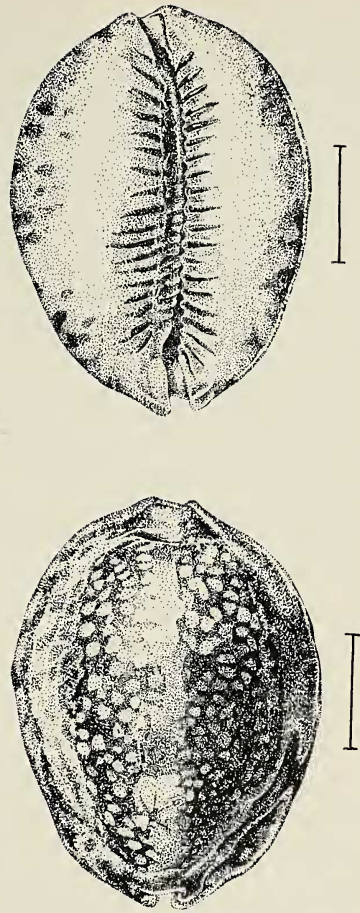


FIG. 16. *Cypraea (Mauritia) depressa* Gray. Onotoa Atoll, Gilbert Islands (USNM 607761).

*Cypraea (Mauritia) maculifera* (Schilder, 1932) (syn. *reticulata* Martyn, 1786, nonbinom.). Tinker (1952) p. 140, 3 figs. on p. 141 [as *C. reticulata* Martyn]; Morris (1952) p. 179, col. pl. 5, fig. 15 [as *C. reticulata* Martyn].

Characteristically 2 to 2.5 inches long with brown teeth and brown dorsal reticulations. Closely resembles *C. depressa* but may be distinguished from that species by the dark brown splotch on its ventral columellar surface.

Ordinarily collected under rocks and loose coral below low tide line on windward ocean reef flats, commonly just shoreward of the reef edge. One specimen in the collections studied was taken from a small reef at a depth

of 4 to 10 feet in the lagoon west of Saipan.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM collections are from the Philippine, Mariana, Caroline, Marshall, Samoan, Cook, Society, Line (Palmyra), and Hawaiian islands.

*Cypraea (Mauritia) mauritiana* Linné, 1758.

Tinker (1952) p. 140, 3 figs. on p. 141;

• Morris (1952) p. 179, pl. 5, fig. 13; Kira (1955) pl. 20, fig. 12.

A large species, characteristically 3.5 to 4 inches long with brown dorsal reticulations and blackish-brown angular margins.

Ordinarily found under rocks or in rock crevices on windward ocean reef flats, commonly just shoreward of the reef edge where the surf is strong. Also taken from the fronts of both windward and leeward reefs, the walls of surge channels in the reef edge, in shallow water on small lagoon reefs, on lagoon reef flats, and along rocky shores. Characteristically lives below low tide line, but also occurs intertidally in moist rock crevices and tide pools. Ingram (1947) collected immature specimens from a pool on a ledge of lava near Hanauma Bay, Oahu. The pool was about 15 feet above the breaking surf at high tide and was sprayed by waves only during high water. Ingram also observed that individuals of the same size ordinarily live together under similar environmental conditions. This species is nocturnal.

GEOGRAPHIC RANGE: USNM collections are from Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society, Tuamotu, and Hawaiian islands, and from southern Japan south to New Guinea and New Caledonia. Allan (1950) reports *C. mauritiana* to be "fairly common" on the Great Barrier Reef of Australia. It is common in Micronesia.

Subgenus EROSARIA Troschel, 1863

*Cypraea (Erosaria) caputserpentis* Linné, 1758.

Tinker (1952) p. 156, 3 figs. on p. 157;

Morris (1952) p. 179, pl. 5, fig. 2; Kira (1955) pl. 19, fig. 24.

Characteristically 1.25 to 1.5 inches long with brown reticulations over a white dorsum, angular brown margins with white or grayish extremities, and white teeth with brown interstices.

In Micronesia, *C. caputserpentis* is apparently most abundant among rocks on windward ocean reef flats, just shoreward of the reef edge. It is also found on the walls of surge channels along the seaward reef edge, on leeward ocean reefs, on lagoon reef flats, and on small lagoon reefs. It ordinarily lives in shallow water below low tide line but also occurs intertidally in moist rock crevices and in tide pools. Ostergaard (1950) reports that in Hawaii, large numbers of this species commonly occur together on shore rocks washed by the surf at high tide.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands, and from southern Japan, the Hawaiian and Line islands south to northern Australia and New Caledonia. A very common species throughout the Indo-Pacific. A form or subspecies of *C. caputserpentis* is found at Easter Island in the eastern Pacific.

*Cypraea (Erosaria) erosa* Linné, 1758.

Tinker (1952) p. 148, 3 figs. on p. 149;

Kira (1955) pl. 19, fig. 25.

Characteristically about 1.5 to 2 inches long, with thickened, pitted margins and extremities which are white with brown ridges. Each margin is medially marked with a large, squarish, purple-brown splotch.

Lives among rocks and coral heads just below low tide line on the outer parts of both seaward and lagoon reefs. Abbott (1950) reports three living specimens from pools on the outer reef of Cocos-Keeling Atoll.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society and Tu-



motu islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia. Fairly common in Micronesia.

*Cypraea (Erosaria) helvola* Linné, 1758.

Tinker (1952) p. 152, 4 figs. on p. 153 [poor]; Morris (1952) p. 181, pl. 5, fig. 9 [poor]; Kira (1955) pl. 19, fig. 14.

Characteristically about three-fourths inch long with brown and white spots over a bluish-gray dorsum, pitted orange-brown margins with violet extremities, and an orange-brown base.

Several specimens in the recent Micronesian collections were found under rocks and loose coral in shallow water on both windward and leeward ocean reef flats of Bikini and Eniwetok. Two other specimens were found living on the leeward side of Onotoa; one among coral on the seaward reef flat, the other in a cranny on a small reef in a pass through the leeward reef. In Hawaii, Ostergaard (1950) collected living specimens in shallow water on Waikiki reef.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Tuamotu and Marquesas islands, and from southern Japan and Hawaii south to New Guinea and the Loyalty Islands. Also reported from northeastern Australia. Common in Micronesia.

*Cypraea (Erosaria) poraria* Linné, 1758.

Tinker (1952) p. 152, 4 figs. on p. 153; Hirase and Taki (1951) pl. 94, fig. 10; Kira (1955) pl. 19, fig. 17.

Characteristically about 0.5 to 0.75 inch long with irregular white spots over a brownish dorsum, a violet base, and pitted violet margins and extremities.

Ordinarily collected among rocks below low tide line on seaward reef flats. One specimen in the present collections was found living among dead coral branches of a small reef on the sandy lagoon shelf at Ifaluk. The top of this reef was usually 2 to 3 feet below the water surface at mean low tide and was

never exposed even during spring tides. Abbott (1950) reports *C. poraria* living under boulders on the seaward portion of the barrier reef at Cocos-Keeling Atoll. According to Ingram (1947) this species is extremely rare in Hawaii. Over a period of several years, he collected only one living specimen, taken from the branches of living coral at a depth of several feet on Waikiki reef, in a moderately heavy surf.

GEOGRAPHIC RANGE: USNM collections are from Ceylon and Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society Islands, and from southern Japan and Hawaii south to New South Wales, Australia, and New Caledonia. Reported from Mauritius. Common in Micronesia.

Subgenus *MONETARIA* Troschel, 1863

*Cypraea (Monetaria) annulus* Linné, 1758.

Morris (1952) p. 181, col. pl. 5, fig. 4 [as *C. annulata* Linné]; Kira (1955) pl. 19, fig. 20.

Characteristically 0.5 to 0.75 inch long. Grayish white with a dark orange ring encircling the central dorsum, which is commonly a darker bluish gray.

The collections studied include only four lots of this species on which there is ecological data. Most of the specimens were found a few feet below low tide line in beds of turtle grass on sandy lagoon shelves. A few were living intertidally in rocky pools on lagoon reef flats. According to Allan (1950), large numbers of *C. annulus* commonly occur together on the coral reefs of northeastern Australia, under stones in shallow water. She also reports their occurrence along the rocky shore of southeastern Australia, at and below low tide line.

GEOGRAPHIC RANGE: USNM collections are from East Africa and the Red Sea eastward throughout the Indian and Pacific oceans to Samoa and Palmyra Atoll, and from southern Japan south to northeastern Australia and New Caledonia. Not found in Hawaii. Uncommon in Micronesia.

*Cypraea (Monetaria) moneta* Linné, 1758.

Tinker (1952) p. 156, 3 figs. on p. 157;

Morris (1952) p. 181, col. pl. 5, fig. 1;

Kira (1955) pl. 19, fig. 23.

Characteristically 0.75 to 1 inch long with thickened margins and extremities and a polished pale yellow or greenish-yellow dorsum.

Lives in a variety of habitats. Abundant under and among rocks and coral heads in shallow water on seaward and lagoon reef flats. Ordinarily occurs below low tide line but also found intertidally in moist rock crevices and in tide pools. Commonly found among seaweed in shallow bays and on sandy lagoon shelves and slopes in about 2 to 12 feet of water. Also taken on small lagoon reefs, on exposed lagoon sand flats, and along rocky ocean shores.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northeastern Australia and New Caledonia. *C. moneta* ranges into the eastern Pacific, occurring at Clipperton Island (Hertlein and Emerson, 1953), and at Cocos and the Galapagos Islands (Ingram, 1951), but it is not found on the west coast of the Americas. It is the most common small cowry in Micronesia.

Subgenus LURIA Jousseume, 1884

*Cypraea (Luria) isabella* Linné, 1758.

Tinker (1952) p. 148, 3 figs. on p. 149;

Morris (1952) p. 180, pl. 5, fig. 6 (poor);

Kira (1955) pl. 19, fig. 26.

Characteristically about 1.25 to 1.5 inches long with an orange or fawn-colored dorsum, dark brown or orange extremities, and a white base. Dorsum covered with thin brown or blackish-brown longitudinal streaks.

Found under rocks and in crannies on seaward reef flats, on small lagoon reefs, and in shallow passes between reef segments. Occurs from just below low tide line to a depth of 8 to 10 feet. Apparently most abundant on lee-

ward reefs or in protected lagoon waters, where it is not exposed to a heavy surf.

GEOGRAPHIC RANGE: Collections are from the African coast (Natal, Durban, South Africa, to the Red Sea) eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to New Guinea and New Caledonia. Reported from southeastern Australia. *C. isabella* also ranges into the eastern Pacific, occurring at Clipperton Island (Hertlein and Emerson, 1953) and at Cocos and the Galapagos Islands (Ingram, 1951), but it is not found on the west coast of the Americas. Common in Micronesia.

Subgenus TALPARIA Troschel, 1863

*Cypraea (Talparia) argus* Linné, 1758.

Hirase and Taki (1951) pl. 92, fig. 1; Kira (1955) pl. 20, fig. 13.

Characteristically 3 to 4 inches long with three medium brown transverse bands on a light fawn-colored dorsum over which are scattered numerous medium brown rings or eyes. Base whitish with four large dark brown splotches, two on each lip.

None of the few specimens in the recent Micronesian collections were taken alive, but data for recently dead specimens indicate that this species lives below low tide line near the edge of seaward reefs.

GEOGRAPHIC RANGE: USNM collections are from the south China coast and the East Indies eastward through the Pacific to Hawaii and Samoa, and from the Ryukyu and Mariana islands south to New Caledonia. Reported from the Seychelles, Madagascar, Mauritius, and northern Australia. Uncommon in Micronesia.

*Cypraea (Talparia) talpa* Linné, 1758.

Tinker (1952) p. 144, 3 figs. on p. 145;

Kira (1955) pl. 20, fig. 11.

Characteristically 2 to 3 inches long with dark brown margins, extremities, and teeth; white interstices; and a light brown dorsum

bearing four darker medium brown transverse bands.

Lives among rocks on both seaward and lagoon reef flats, invariably below low tide line.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and the Seychelles eastward through the Pacific Ocean to Hawaii and the Tuamotus, and from the Ryukyu and Mariana islands south to northern Australia and New Caledonia. Uncommon in Micronesia.

Subgenus *CALLISTOCYPRAEA* Schilder, 1927

*Cypraea* (*Callistocypraea*) *testudinaria* Linné, 1758.

Hirase and Taki (1951) pl. 92, fig. 7; Kira (1955) pl. 20, fig. 18.

Characteristically about 4.5 to 6 inches long. Elongate, with a light tan dorsum mottled and dotted with dark brown and covered with numerous fine white specks. Base fawn-colored.

Lives on seaward reef flats and on small lagoon reefs, invariably below low tide line.

**GEOGRAPHIC RANGE:** USNM records are from Zanzibar on the east African coast; from Mauritius, Ceylon and Cocos-Keeling Atoll in the Indian Ocean; and from the Ryukyu, Philippine, Caroline, Marshall, Gilbert, Samoan, and Fiji islands in the Pacific. Uncommon in Micronesia, and not reported from Australia or Hawaii.

Subgenus *PALMADUSTA* Iredale, 1930

*Cypraea* (*Palmadusta*) *imbriata* Gmelin, 1791.

Tinker (1952) p. 154, 8 figs. on p. 155;  
Kira (1955) pl. 19, fig. 2.

Characteristically 0.5 to 0.625 inch long with a transverse band of irregular brown markings extending medially over a purplish gray dorsum and columellar margin onto a white base. Extremities brilliant purple both dorsally and ventrally. Teeth and interstices white.

Of the recent Micronesian specimens, only

one was taken alive—from branching coral (*Stylophora* sp.) on the lagoon reef slope off Ine Village, Arno Atoll. Locality notes accompanying the Hawaiian specimens of *C. fimbriata* in the U. S. National Museum contain the following observation by the collector, Ditlev Thaanum: "Among branches of coral, live and dead, under rocks, etc. Most frequent on rocks covered with a bright orange-yellow sponge (?) the color of the animal of [*C. fimbriata*]." "

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and the Gulf of Suez eastward through the Pacific to the Society, Tuamotu, and Hawaiian islands, and from southern Japan south to New Guinea. Reported from northern Australia and New South Wales. Rare in Micronesia.

Subgenus *ERRONEA* Troschel, 1863

*Cypraea* (*Erronea*) *caurica* Linné, 1758.

Hirase and Taki (1951) pl. 93, fig. 11.

Characteristically 1.5 to 2 inches long with numerous medium brown specks over a greenish or bluish dorsum, commonly with three brownish transverse dorsal bands, produced margins and extremities which are whitish with dark brown spots, a white base and teeth, and light orange interstices.

Only two specimens in the recent Micronesian collections were taken alive. Both were found under rocks on shallow lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to Fiji and Samoa, and from southern Japan south to northern Australia and New Caledonia. Uncommon in Micronesia. Not reported from Hawaii.

Subgenus *STAPHYLAEA* Jousseaume, 1884

*Cypraea* (*Staphylaea*) *nucleus* Linné, 1758.

Tinker (1952) p. 160, 2 figs. on p. 161;  
Morris (1952) p. 182, col. pl. 5, fig. 7;  
Kira (1955) pl. 18, fig. 20.

Characteristically 0.5 to 0.75 inch long with

pale rust-colored pustules and ridges covering a grayish dorsum, a distinct median dorsal furrow, extremities produced and beaked, and teeth extending over the base onto the margins.

Apparently lives below low tide line on both seaward and lagoon reef flats. The one specimen in the present Micronesian collections which was taken alive came from among small reefs on the sandy lagoon shelf at Ifaluk. These reefs are never exposed, their surfaces ordinarily being covered by 3 to 5 feet of water at low tide.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and Mauritius eastward throughout the Indian and Pacific oceans to the Society, Tuamotu, and Line islands, and from southern Japan south to New Guinea and New Caledonia. Reported from northern Australia and Hawaii. Uncommon in Micronesia.

#### Family CASSIDIDAE—Helmet Shells

##### Genus CASSIS Scopoli, 1777

*Cassis cornuta* (Linné, 1758).

Hirase and Taki (1951) pl. 97, fig. 1; Tinker (1952) p. 128, fig. on p. 129; Morris (1952) p. 183, pl. 38, fig. 14.

The largest species of *Cassis*, commonly 10 to 14 inches long. Whitish with 7 or 8 dark brown rays on the outer lip. Aperture flesh-colored and polished.

Ordinarily lives in sand among small reefs, on lagoon slopes at depths of 5 to 20 feet. According to USNM collection notes by John Wells, the Arno natives claim that *C. cornuta* comes up from the lagoon bottom onto the lagoon reef flat during new moon. Perhaps corroborating this behavior is the fact that two of the present Ifaluk specimens were collected during new moon along the shallow shore of the lagoon.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to Samoa, and from the Ryukyu and Marshall islands south to the

Caroline Islands. Reported from southern Japan, Hawaii, and northeastern Australia. Fairly common in Micronesia.

##### Genus PHALIUM Link, 1807

Subgenus CASMARIA H. and A. Adams, 1853

*Phalium (Casmaria) vibex* (Linné, 1758).

Tinker (1952) p. 130, 3 figs. on p. 131; Morris (1952) p. 183, pl. 38, fig. 13.

Characteristically about two inches long, whitish or brownish with dark brown rays on the outer lip and a polished white aperture.

Apparently lives on seaward reef flats in shallow water below low tide line. The one specimen in the recent Micronesian collections which was taken alive was found among rocks in about 3 feet of water on the seaward reef flat at Ifaluk. Edmondson (1946) reports that, although *P. vibex* is a common Hawaiian species, it is seldom taken alive on the reefs. This comment indicates that the species lives in deeper water off the reef front.

**GEOGRAPHIC RANGE:** Fairly common throughout the Indo-Pacific. USNM collections are from East Africa and Mauritius eastward throughout the Indian and Pacific oceans to Hawaii and the Tuamotu Islands, and from the Ryukyu Islands south to northern Australia and New Caledonia.

#### Family CYMATIIDAE—Triton Shells

##### Genus CYMATIUM Röding, 1798

Subgenus LAMPUSIA Schumacher, 1817

*Cymatium (Lampusia) chlorostomum* (Lamarck, 1822).

Tinker (1952) p. 126, 2 figs. on p. 127; Morris (1952) p. 184, col. pl. 6, fig. 10.

Characteristically 1.75 to 4 inches long and solid, with strong varices, prominent columellar plications, and apertural teeth. Shell whitish with brownish spots and a bright orange aperture and columella.

Ordinarily lives among rocks and in tide pools on windward ocean reef flats, com-

monly a few feet below low tide line toward the reef edge. Occasionally found on lagoon reef flats. One specimen in the recent Micronesian collections was taken in 18 feet of water from the sandy lagoon slope of Rongelap Atoll. At Eniwetok, Morrison observed this species feeding on ceriths.

**GEOGRAPHIC RANGE:** USNM collections are distributed from Mauritius eastward through the Indian and Pacific oceans to the Society and Marquesas islands, and from southern Japan south to Cocos-Keeling Atoll, the Caroline and Fiji islands. Common in Micronesia. Reported from Hawaii but not from Australia. *C. chlorostomum* also occurs in southeast Florida, the West Indies, and Bermuda.

*Cymatium (Lampusia) gemmatum* (Reeve, 1844)  
(syn. *mundum* Gould, 1851).

Tinker (1952) p. 124, 2 figs. on p. 125.

Characteristically 1.25 to 1.75 inches long. Shell white or whitish with a yellowish hairy periostracum and a white aperture and columella.

Found under rocks and coral on shallow reef flats, ordinarily just below low tide line on lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM collections are from Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to Hawaii and the Tuamotu Islands, and from southern Japan south to the East Indies, the Solomon Islands, and Fiji. Reported from Mauritius and northern Australia. Uncommon in Micronesia.

Subgenus **GUTTURNIUM** Mörch, 1852

*Cymatium (Gutturnium) muricinum* Röding, 1798 (syn. *tuberosum* Lamarck, 1822).

Morris (1952) p. 184, col. pl. 6, fig. 1 [as *C. tuberosum* Lamarck]; Tinker (1952) p. 124, 2 figs. on p. 125 [as *C. tuberosum* Lamarck].

Characteristically 1.75 to 3 inches long, with a slender, elongate anterior canal and a conspicuous columellar callus. Teeth, lips,

and columella polished white. Aperture dark orange-brown within.

Ordinarily lives in sandy lagoons, frequently a few feet below low tide line on lagoon shelves and lagoon reef flats, and to depths of 150 feet on lagoon floors. Also found on the deeper portions of seaward reef flats.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward throughout the Indian and Pacific oceans to the Hawaiian and Tuamotu islands, and from southern Japan south to New Guinea and New Caledonia. Fairly common in Micronesia, but not reported from Australia. *C. muricinum* also occurs in southeast Florida, the West Indies, and Bermuda.

Genus **CHARONIA** Gistel, 1848

*Charonia tritonis* (Linné, 1758).

Hirase and Taki (1951) pl. 95, fig. 9; Tinker (1952) p. 114, fig. on p. 115; Morris (1952) p. 185, col. pl. 6, fig. 9; Kira (1955) pl. 21, fig. 15.

The largest member of the family Cymatiidae and one of the largest gastropods in the Indo-Pacific, commonly reaching up to 16 to 18 inches long.

Apparently lives on sandy bottoms of shallow bays and lagoons, and in deeper water off the edge of seaward reefs.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to Hawaii and Samoa, and from the Ryukyu and Mariana islands south to the New Hebrides and Fiji. Also reported from northern Australia and New South Wales.

Family **BURSIDAE**—Frog Shells

Genus **BURSA** Röding, 1798

*Bursa bubo* (Linné, 1758) (syn. *rubeta gigantea* E. A. Smith, 1914).

Tinker (1952) p. 120, fig. on p. 121 [as *B. lampas* Linné].

A ponderous shell easily recognized by its large size, specimens commonly attaining a length of 9 to 10 inches.

Apparently lives among coral at a depth of several fathoms off the edge of seaward reefs.

GEOGRAPHIC RANGE: USNM records are from East Africa, the Ryukyu, Philippine, Caroline, Marshall, and Fiji islands, and from New Caledonia. Reported from northern Australia and Hawaii. Specimens from Micronesia are few, possibly because of their relatively inaccessible habitat.

*Bursa bufonia* (Gmelin, 1791).

Hirase and Taki (1951) pl. 96, fig. 8; Tinker (1952) p. 120, 4 figs. on p. 121; Morris (1952) p. 186, col. pl. 6, fig. 4.

Characteristically 2 to 2.5 inches long with curved anterior and posterior canals. Shell whitish with brown markings. Commonly encrusted with calcareous algae, vermetids, and Foraminifera. Aperture white or yellowish within.

Ordinarily lives among rocks and loose coral on windward ocean reef flats, commonly in turbulent water just shoreward of the reef edge, and invariably below low tide line. In the Marshall Islands, *B. bufonia* was abundant along the windward shores of Bikini, Eniwetok, Rongelap, and Rongerik, on the seaward reef flats which are covered by 6 inches to a foot of water at extreme low tide. The species was also found on windward lagoon reef flats of atolls with broad lagoons, where a strong surf is present on the windward lagoon shore (e.g., Bikini and Eniwetok). At Ifaluk, specimens were taken only on the windward ocean reef flats. Also, at Onotoa and Saipan *B. bufonia* was found exclusively along windward ocean shores.

GEOGRAPHIC RANGE: USNM records are from New Guinea, the Philippine, Mariana, Marshall, Gilbert, Caroline, Solomon, Samoan, Tuamotu, Phoenix, and Line islands. Reported from Mauritius in the Indian Ocean, from southern Japan, and from Hawaii, but

not from Australia. A very common species in Micronesia.

*Bursa granularis* Röding, 1798 (syn. *affinis* Broderip, 1833; *granifera* Lamarck, 1816). Tinker (1952) p. 122, 2 figs. on p. 123 [as *B. affinis* Broderip]; Morris (1952) p. 185, col. pl. 6, fig. 5 [as *B. affinis* Broderip].

Characteristically 0.75 to 2 inches long. Recognized by its laterally compressed shell and its vertically aligned varices.

Lives under rocks and in tide pools of seaward reef flats, both windward and leeward, ordinarily slightly below low tide line.

GEOGRAPHIC RANGE: USNM collections are from East Africa eastward throughout the Indian and Pacific oceans to Hawaii and the Tuamotu Islands, and from southern Japan south to New Caledonia, but the species is uncommon in Micronesia. There are worn USNM specimens from Clipperton and Clarion islands in the eastern Pacific; the Clipperton occurrence is confirmed by Hertlein and Emerson (1953). *B. granularis* is reported from northern Australia. It also occurs in southeast Florida and the West Indies, but it is not found on the west America coast.

#### Family TONNIDAE—Tun Shells

Genus TONNA Brünnich, 1772 (syn. *Cadus* Röding, 1798; *Dolium* Lamarck, 1801; *Cadium* Link, 1807)

*Tonna cepa* (Röding, 1798) (syn. *olearium* of authors).

Characteristically 3 to 4.5 inches long. Differs from *T. perdix* in having a more globose shell, deep, almost channelled sutures, and somewhat shouldered whorls. Also, the spiral grooves of *T. cepa* are deeper than those of *T. perdix*.

Probably lives in offshore ocean waters. The recent Micronesian collections include only one shell, obtained from natives at Onotoa. Abbott (1950) reports that empty shells of this species are plentiful in reef pools at Cocos-Keeling Atoll.

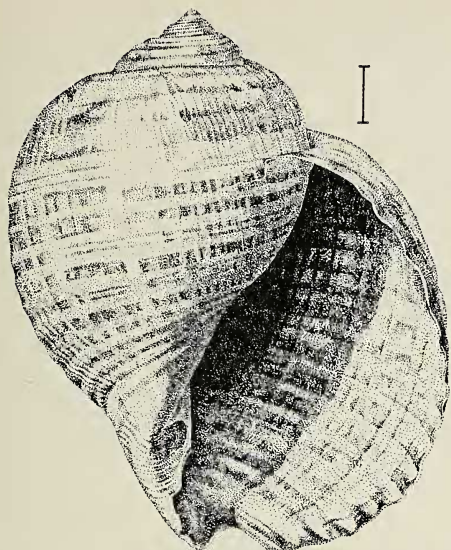


FIG. 17. *Tonna cepa* (Röding). Onotoa Atoll, Gilbert Islands (USNM 607555).

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and Mauritius eastward to Fiji, and from the Ryukyu Islands south to New Guinea. Uncommon in Micronesia. Not reported from Hawaii.

*Tonna perdix* (Linné, 1758).

Hirase and Taki (1951) pl. 98, fig. 7; Tinker (1952) p. 132, figs. on p. 133; Morris (1952) p. 183, pl. 38, fig. 11.

Characteristically 4.5 to 7 inches long and elongate with a raised spire. See *T. cepa* for comparative description.

*T. perdix* lives in offshore ocean waters, but empty shells are frequently washed ashore. According to Tinker (1949), this species occurs in less than 10 to well over 100 feet of water but is most abundant in depths greater than 75 feet. Allan (1950) reports *T. perdix* to be a common shell on the outer reefs of northern Australia.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa eastward through the Indian and Pacific oceans to Hawaii and Samoa. Reported from southern Japan and the Great Barrier Reef, Australia. A fairly common species in the Indo-Pacific.

Genus *MALEA* Valenciennes, 1833

*Malea pomum* (Linné, 1758).

Hirase and Taki (1951) pl. 98, fig. 3 [as *Quimalea pomum* (Linné)]; Tinker (1952) p. 136, 3 figs. on p. 137; Morris (1952) p. 183, pl. 38, fig. 12.

Characteristically 2 to 3 inches long with well-defined teeth on its thickened outer lip.

The recent Micronesian collections contain many empty shells taken from seaward reefs and beaches, indicating that *M. pomum* lives in deeper water beyond the reef edge. According to Tinker (1949), this species is the third most abundant member of the Tonnidae in Hawaii. He reports that it is most numerous at depths of about 100 feet, is occasionally taken in shallower water, and is uncommon at depths of less than 40 or 50 feet.

**GEOGRAPHIC RANGE:** Common in Micronesia, though rarely found alive. USNM collections are from East Africa eastward through the Indian and Pacific oceans to Samoa, and from the Ryukyu and Hawaiian islands south to the Celebes and New Caledonia. Reported from northern Australia.

Family MURICIDAE—Murex and Rock Shells

Genus *MUREX* Linné, 1758

Subgenus *CHICOREUS* Montfort, 1810

*Murex (Chicoreus) brunneus* (Link, 1807) (syn. *adustus* Lamarck, 1822).

Hirase and Taki (1951) pl. 109, fig. 4 [as *Chicoreus rubicundus* (Perry)].

Characteristically 1.5 to 2 inches long.

Ordinarily found in quiet, protected water from about 1 foot below low tide line to depths of 150 to 200 feet. Specimens studied were collected from crannies in both dead and living coral on small lagoon reefs, and also from among coral-algal rock on sandy lagoon floors.

**GEOGRAPHIC RANGE:** USNM records are from Mauritius and the coast of India east-

ward through the Indian and Pacific oceans to the Marshall, Gilbert, and Samoan islands, and from southern Japan, the Ryukyu and Mariana islands south to New Guinea and New Caledonia. Reported from northern Australia, but not found in Hawaii. Fairly common in Micronesia.

Genus DRUPA Röding, 1798

*Drupa grossularia* Röding, 1798 (syn. *digitata* Lamarck, 1816).

Tinker (1952) p. 96, 3 figs. on p. 97 [as *D. digitata* Lamarck]; Morris (1952) p. 187, pl. 39, fig. 3, col. pl. 8, fig. 5 [as *Sistrum digitatum* Lamarck]; Kira (1955) pl. 23, fig. 3.

Characteristically 1 to 1.5 inches long, with an orange aperture and, in adult specimens, with fingerlike protuberances on the outer lip. This *Drupa* is commonly so encrusted with coralline algae, vermetids, Foraminifera, and other growth, that its shape is entirely obscured and it appears to be part of its substrate.

Ordinarily found on windward ocean reef flats, clinging to the rocks near low tide line. Less frequently occurs on leeward ocean reefs. Only one specimen in the recent Micronesian collections was from a lagoon habitat. It was taken alive from coral-algal rock at a depth of 32 to 38 feet in the lagoon entrance west of Saipan.

GEOGRAPHIC RANGE: Apparently limited to the Pacific, and fairly common in Micronesia. USNM collections are from Formosa and the Philippines eastward to the Hawaiian, Society, and Tuamotu islands, and from the Ryukyus south to New Guinea and Fiji. Reported from northern Australia. In the Indian Ocean, *D. grossularia* is replaced by the subspecies *D. lobata* which is recognized by its dark brown aperture.

*Drupa morum* Röding, 1798 (syn. *horrida* Lamarck, 1816; *violacea* Schumacher, 1817; *neritoides* Gmelin, 1791, not Linné, 1758). Hirase and Taki (1951) pl. 110, fig. 8;

Tinker (1952) p. 94, 3 figs. on p. 95 [as *D. horrida* Lamarck]; Kira (1955) pl. 23, fig. 8.

Characteristically about one and three-fourths inches long.

*D. morum* lives among rocks and in crannies of windward ocean reef flats. It is also common on windward lagoon reef flats of broad atolls, such as Bikini and Eniwetok, where the surf is strong, but it seldom occurs on leeward reefs. Ordinarily, it is found near low tide line, or on the reef edge, but it has also been taken from tide pools across the entire reef flat. Specimens are commonly so overgrown with coralline algae, vermetids, Foraminifera, and *Hipponix* they are almost indistinguishable from the reef surface.

GEOGRAPHIC RANGE: USNM collections are from Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to the East Indies and New Caledonia. Common in Micronesia. Reported from northern Australia and also from Clipperton Island in the eastern Pacific (Hertlein and Emerson, 1953).

*Drupa ricinus* (Linné, 1758) (syn. *hystrix* Linné, 1758, not Lamarck, 1822; *arachnoides* Lamarck, 1816).

Hirase and Taki (1951) pl. 110, fig. 11;

Tinker (1952) p. 96, 3 figs. on p. 97.

Characteristically 0.75 to 1 inch long, and ordinarily encrusted with coralline algae, vermetids and other growths.

Habitat similar to *D. morum*.

GEOGRAPHIC RANGE: USNM collections are from Mauritius eastward through the Indian and Pacific oceans to the Marquesas Islands, and from southern Japan and Hawaii south to the Great Barrier Reef, Australia, and New Caledonia. Very common in Micronesia. Hertlein and Emerson (1953) report *D. ricinus* from Clipperton Island in the eastern Pacific.

*Drupa rubusidaeus* Röding, 1798 (syn. *hystrix* Lamarck, 1822).

Hirase and Taki (1951) pl. 110, fig. 10.



Characteristically 1 to 1.25 inches long.

Lives on both windward and leeward ocean reef flats, under rocks and loose coral and in tide pools near, or a few feet below, low tide line. Also taken on living coral heads (*Pocillopora* sp.) off the seaward reef edge in 10 to 15 feet of water.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa and Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from the Ryukyu Islands south to New Guinea and New Zealand. Reported from northeastern Australia but not from Hawaii. Uncommon in Micronesia.

Genus *MORULA* Schumacher, 1817

*Morula anaxeres* (Kiener, 1836).



FIG. 18. *Morula anaxeres* (Kiener). Ifaluk Atoll, Caroline Islands (USNM 614192).

Characteristically about one-half inch long with prominent white tubercles and a polished, dark brown aperture.

Ordinarily lives under rocks and in rocky tide pools of windward ocean reef flats. Also found on leeward ocean reefs and on windward lagoon reefs. Occurs from the upper intertidal zone to just shoreward of the reef edge.

**GEOGRAPHIC RANGE:** USNM collections are from the west coast of India, and the Philippine, Caroline, and Marshall islands. There is

one USNM record from Palmyra Atoll but none from Hawaii. Reported from the Ryukyu Islands. Uncommon in Micronesia. Probably more widespread and possibly recorded as *M. uva* because of its similarity to that common species.

*Morula concatenata* (Lamarck, 1822) (syn. *fragum* Blainville, 1832).

Hirase and Taki (1951) pl. 110, fig. 18.

Characteristically about one inch long and yellowish-white with a purple-violet or orange-red aperture.

The recent Micronesian collections contain but one specimen, found living on small lagoon reefs in about one foot of water at Eniwetok. According to earlier USNM collection notes, *M. concatenata* occurs exclusively on living coral.

**GEOGRAPHIC RANGE:** USNM records are from Mauritius eastward through the Indian and Pacific oceans to the Hawaiian and Society islands, and from the Ryukyu Islands south to New Guinea and Fiji. Uncommon in Micronesia.

*Morula elata* (Blainville, 1832) (syn. *spectrum* Reeve, 1846; *ochrostoma* Tryon, 1880, not Blainville, 1832).

Characteristically 0.75 to 1 inch long and white both exteriorly and within the aperture.

Lives on small lagoon reefs, on coral in channels between reef segments and on sea-

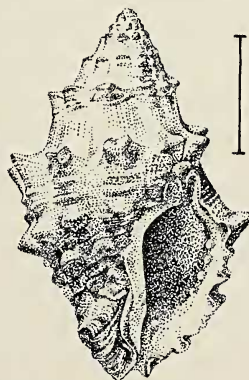


FIG. 19. *Morula elata* (Blainville). Kwajalein Atoll, Marshall Islands (USNM 486005).

ward reef flats, both windward and leeward, from about low tide line to depths of 25 feet. According to Bayer, *M. elata* occurs exclusively on branches of living coral, most frequently on *Porites* sp., but also on *Stylophora* sp. and *Seriatopora* sp.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific. USNM collections are from Java and Borneo east to the Tuamotu Islands, and from southern Japan and Hawaii south to Queensland, Australia, and Fiji. Fairly common in Micronesia.

*Morula fiscella* (Gmelin, 1791).

Tinker (1952) p. 92, 3 figs. on p. 93.

Characteristically about 0.75 to 1 inch long with brown bands and a pale violet aperture.

The recent Micronesian collections contain only two lots of this species, one found under rocks in a tide pool on the seaward reef flat at Ifaluk and the other found among intertidal rocks of Tomil Harbor beach, Yap.

**GEOGRAPHIC RANGE:** USNM records are from South Africa, Mauritius, Java, Borneo, Gulf of Siam, China coast, southern Japan, the Philippines, northern Australia, and Fiji. Reported from Hawaii. Uncommon in Micronesia.

*Morula granulata* (Duclos, 1832) (syn. *tuberculata* Blainville, 1832).

Hirase and Taki (1951) pl. 110, fig. 15;

Tinker (1952) p. 90, 2 figs. on p. 91 [as *M. tuberculata* Blainville]; Morris (1952) p. 187, pl. 39, fig. 11 [as *M. tubercula* Blainville].

Characteristically about one inch long.

Habitat similar to that of *Drupa morum*.

**GEOGRAPHIC RANGE:** USNM records are from the entire coast of Africa eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to the East Indies, New Guinea, and New Caledonia. Common in Micronesia, but not reported from Australia.

*Morula ochrostoma* (Blainville, 1832).

Tinker (1952) p. 90, 5 figs. on p. 91 (poor).

Characteristically 1 to 1.5 inches long. Entirely white except for its orange aperture which distinguishes it from *M. elata*.

Lives among rocks and corals on seaward and lagoon reef flats, both windward and leeward, from near low tide line to a depth of 6 feet or so.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific. USNM records are from the Philippines eastward to the Hawaiian and Society islands, and from southern Japan south to Queensland, Australia, and the Loyalty Islands. Uncommon in Micronesia.

*Morula triangulatum* (Pease, 1867).



FIG. 20. *Morula triangulatum* (Pease). Eniwetok Atoll, Marshall Islands (USNM 581860).

Characteristically 0.75 to 1 inch long with a purple aperture, and triangular in shape.

Lives among rocks and in tide pools of both windward and leeward ocean reef flats from the lower to the upper intertidal zone.

**GEOGRAPHIC RANGE:** USNM records are from the Red Sea, Mauritius, the East Indies, the Philippine, Marshall, Hawaiian, Line, Tuamotu, Samoan, Tonga, and Fiji islands and from the Schouten Islands off New Guinea. Fairly common in Micronesia.

*Morula uva* Röding, 1798 (syn. *nodus* Lamarck, 1816; *morus* Lamarck, 1822).

Morris (1952) p. 187, col. pl. 8, fig. 1; pl. 39, fig. 2 [as *M. nodus* St. Vincent].

Characteristically 0.5 to 0.75 inch long.

Found in crannies or among rocks on exposed reef flats, both seaward and lagoon.

Has also been taken, though uncommonly, from small reefs on lagoon floors.

**GEOGRAPHIC RANGE:** USNM records are from South Africa and Mauritius eastward through the Indian and Pacific oceans to the Tuamotu and Society islands and to Clipperton Island in the eastern Pacific, and also from the Ryukyu and Hawaiian islands south to the East Indies and Fiji. Reported from northern Australia. Common in Micronesia.

Genus *MACULOTRITON* Dall, 1904

*Maculotriron digitalis* (Reeve, 1844).



FIG. 21. *Maculotriron digitalis* (Reeve). Ifaluk Atoll, Gilbert Islands (USNM 614193).

Characteristically about one-half inch long. Sculptured with spiral cords and low, broad transverse ribs. Whitish in color with a spiral pattern of yellowish or chestnut-brown spots, which is frequently obscured.

Ordinarily found under rocks and in tide pools on windward ocean reef flats.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific. USNM records are from southern Japan, the Bonin, Caroline, Marshall, Gilbert, Hawaiian, Line, Society, and Tuamotu islands. Reported from northeastern Australia. Uncommon in Micronesia.

Genus *THAIS* Röding, 1798

*Thais armigera* (Link, 1807).

Hirase and Taki (1951) pl. 110, fig. 2;

Tinker (1952) p. 98, 4 figs. on p. 99 [as *T. affinis* Reeve].

Characteristically about three inches long and whitish with a yellowish-pink aperture.

Ordinarily found clinging to rocks of windward ocean reef flats, just shoreward of the reef edge. Also occurs along windward lagoon margins of broad atolls where the lagoon reef flat exhibits features of a seaward reef. Invariably found in shallow water, either just

below low tide line or in reef flat tide pools. Commonly so thickly encrusted with coral-line algae, Foraminifera, vermetids, and *Hipponix* it is difficult to distinguish from the reef surface.

**GEOGRAPHIC RANGE:** USNM records are from Mauritius and Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands, and from southern Japan south to the Solomon Islands and New Caledonia. Reported from northern Australia and Hawaii. Fairly common in Micronesia.

*Thais hippocastanum* (Linné, 1758) (syn. *aculeata* Deshayes, 1844; *pseudohippocastanum* Dautzenberg, 1929).

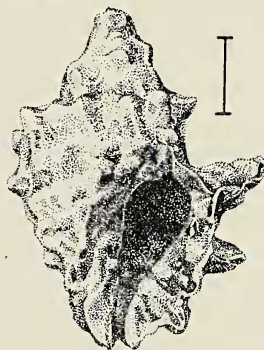


FIG. 22. *Thais hippocastanum* (Linné). Kwajalein Atoll, Marshall Islands (USNM 607586).

Characteristically 1.5 to 2.5 inches long. Resembles *T. tuberosa* in its shape, knobby surface, and yellowish-white aperture. However, unlike *T. tuberosa*, the brown color on its outer lip extends into the aperture as spiral bands, and the brown color on its columella is diffused instead of in distinct spots.

Ordinarily lives among rocks and in sandy-rocky tide pools on seaward reef flats, both windward and leeward. Occurs across the reef from near low tide line to the upper intertidal zone. Also found, though infrequently, on lagoon reef flats. Specimens are often heavily encrusted and appear to be part of the reef surface.

**GEOGRAPHIC RANGE:** USNM records are from the east coast of Africa eastward through

the Indian and Pacific oceans to Palmyra Atoll and the Tuamotu Islands, and from southern Japan south to New Guinea, Fiji, and Tonga. Fairly common in Micronesia, but not reported from Australia or Hawaii.

*Thais tuberosa* Röding, 1798 (syn. *pica* Blainville, 1832).

Characteristically 1.5 to 2.25 inches long. Triangular in shape and covered with broad, pointed knobs. Aperture typically yellowish-white with a few large, dark brown spots on both the outer lip and columella.

The recent Micronesian collections include only two specimens, both from the windward shore of Saipan. They were found living in shallow water on rocky intertidal reef flats.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM records are from the Philippines eastward through Micronesia to the Society and Tuamotu islands, and from southern Japan and the Ryukyu Islands south to northern Australia. Apparently uncommon in Micronesia. Not reported from Hawaii.

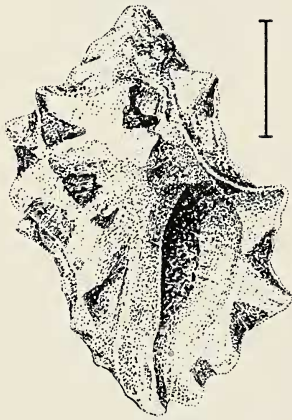


FIG. 23. *Thais tuberosa* Röding. Samoa (USNM 305758).

#### Genus PURPURA Bruguière, 1789

*Purpura persicum* (Linné, 1758).

Characteristically 2 to 3.5 inches long. Exterior brownish with spiral lines of alternating brown and white elongate spots. Aperture orange or flesh-colored.

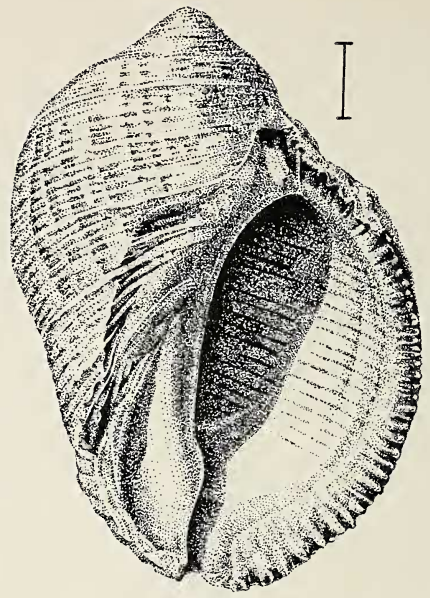


FIG. 24. *Purpura persicum* (Linné). Ifaluk Atoll, Caroline Islands (USNM 614202).

A single specimen was found living on the windward shore of Ifaluk, clinging to the rocky edge of the seaward reef flat, exposed to the breaking surf.

GEOGRAPHIC RANGE: USNM records are from Mauritius, Ceylon, Cocos-Keeling Atoll, the East Indies, and the Philippine, Ryukyu, Bonin, Mariana, Caroline, Gilbert, and Loyalty islands. Reported from northern Australia but not from Japan or Hawaii. Uncommon in Micronesia.

#### Genus NASSA Röding, 1798

*Nassa sertum* (Bruguière, 1789).

Hirase and Taki (1951) pl. 110, fig. 7 [as *Nassa francolinus* Bruguière]; Tinker (1952) p. 88, 5 figs. on p. 89; Morris (1952) p. 191, pl. 39, fig. 12.

Characteristically 1.5 to 2 inches long.

Ordinarily lives among rocks near or slightly below low tide line on both seaward and lagoon reef flats, commonly just shoreward of the reef edge. One specimen, from Ifaluk, was found on a small lagoon reef in 3 to 5 feet of water.

GEOGRAPHIC RANGE: USNM records are from Anna Island and Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands, and from the Ryukyu, Hawaiian and Line islands south to New Guinea and New Caledonia. Fairly common in Micronesia. The foregoing range includes *N. francolinus*, the Hawaiian form or subspecies which is entirely smooth and bears well-defined tentlike markings.

Family MAGILIDAE—Coral Snails

Genus CORALLIOPHILA H. and A. Adams,  
1853

*Coralliophila bulbiformis* (Conrad, 1837).

Tinker (1952) p. 104, 2 figs. on p. 105.

Characteristically 0.75 to 1.25 inches long. Shell white or yellowish, and purple within the aperture. Some authors regard *C. bulbiformis* as a subspecies of *C. violacea*. However, it is here considered a distinct species, because its shell is covered with scaly spiral ridges, whereas the shell of *C. violacea* is relatively smooth.

A single specimen was found living on a small lagoon reef in about 10 feet of water on the sandy lagoon shelf at Ifaluk.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM records are from southern Japan, the Ryukyu, Philippine, Caroline, Hawaiian and Tuamotu islands and from Samoa, New Guinea, and northern Australia. Uncommon in Micronesia.

*Coralliophila erosa* (Röding, 1798) (syn. *exarata* Pease, 1861; *galea* Reeve, 1846).

Tinker (1952) p. 104, 3 figs. on p. 105 [as *C. deformis* Lamarck].

Characteristically 1.25 to 1.75 inches long. Shell white both exteriorly and within the aperture and sculptured with fine, scaly spiral ridges and obscure axial ribs which are particularly prominent on the spire.

The recent Micronesian collections contain only one specimen, taken from coral at a

depth of about six feet in the lagoon at Ifaluk.

GEOGRAPHIC RANGE: USNM records are from Mauritius and Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to Hawaii and Samoa, and from southern Japan south to the East Indies, New Guinea, and Fiji. Not reported from Australia. Uncommon in Micronesia.

*Coralliophila violacea* (Kiener, 1836) (syn. *neritoidea* Gmelin, 1791; *squamulosa* Reeve, 1846).

Hirase and Taki (1951) pl. 111, fig. 8; Tinker (1952) p. 104, 3 figs. on p. 105 [as *C. neretoidea* Lamarck].

Characteristically 1 to 1.5 inches long and whitish with a bright violet aperture.

*C. violacea* is a solitary species which lives in pocketlike depressions on coral. It invariably occurs on living corals and may be dependent upon them for nourishment. Specimens in the recent Micronesian collections were found on species of *Porites* on small lagoon reefs and on small reef patches in lagoons. *C. violacea* lives below low tide line, typically at depths of a few feet.

The eggs of this species are held in capsules under the shell of the female until the pelagic larvae hatch. After a free-swimming period, the larvae settle upon coral, and, as noted above, this habitat is maintained by the adult form.

GEOGRAPHIC RANGE: The commonest *Coralliophila* in the Indo-Pacific. USNM records are from Mauritius in the Indian Ocean eastward through the Pacific to the Hawaiian and Tuamotu islands, and from southern Japan south to northern Australia and the Loyalty Islands.

Genus QUOYULA Iredale, 1912

The collections studied include two species of *Quoyula*; *Q. monodonta* with very fine, spiral ridges, and *Q. madreporarum* with coarser, scaly spiral ridges. *Q. madreporarum* tends to be more elongate than *Q. monodonta*. However, both species vary in shape, because they

live embedded in coral, and their shells become adapted to the configuration of the narrow cavities in which they reside. Thus the only consistent means of recognition is the difference in external sculpture. The sculpturing is, however, commonly obscured by encrustations, and consequently it is difficult to distinguish one species from the other.

*Quoyula madreporarum* (Sowerby, 1834).

Tinker (1952) p. 104, 3 figs. on p. 105 [as *Rhizochilus madreporarum* Sowerby].

Micronesian specimens are characteristically 0.5 to 0.75 inch long, but Hawaiian specimens attain lengths of 1.25 inches. Shell whitish with a purple aperture.

*Q. madreporarum* lives embedded in pocket-like depressions on coral. It is ordinarily found a few feet below low tide line on small lagoon reefs or on seaward reef flats. It apparently lives exclusively on living coral and commonly on branching species. Specimens in the present collections were found on species of *Stylophora*, *Pocillopora* and *Montipora*. Encrustations on the shells of both *Q. madreporarum* and *Q. monodonta* make them difficult to distinguish from their coral substrate.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific. USNM records are from southern Japan, the Caroline, Marshall, and Hawaiian islands, and from Johnston Island and Pearl and Hermes Reef. Uncommon in Micronesia.

*Quoyula monodonta* (Blainville, 1832).

Hirase and Taki (1951) pl. 111, fig. 14.

Characteristically about one-half inch long and whitish with a purple aperture. Perfect specimens possess a single tooth at the base of the columella.

*Q. monodonta* lives in pocketlike depressions on coral. The recent Micronesian collections indicate that it occurs exclusively on living coral, typically on branching species such as *Pocillopora*, *Seriatopora*, and *Stylophora*, and on branching forms of *Porites*. It is most commonly found on small reefs in lagoons or protected harbors, from slightly below low

tide line to depths of 30 or 40 feet, but it has also been taken on seaward reef flats, just shoreward of the reef edge. At Ifaluk, specimens were found with egg cases enveloped under the foot.

**GEOGRAPHIC RANGE:** USNM records are from the Red Sea and Ceylon in the Indian Ocean eastward through the Pacific beyond the Hawaiian and Tuamotu islands to the coast of Lower California at Cape San Lucas, Acapulco, and Espiritu Santo Island; and also from the Philippine and Mariana islands south to Queensland, Australia, and the Loyalty Islands. Reported from southern Japan. Very common in Micronesia.

Genus *MAGILUS* Montfort, 1810

*Magilus antiquus* Montfort, 1810.

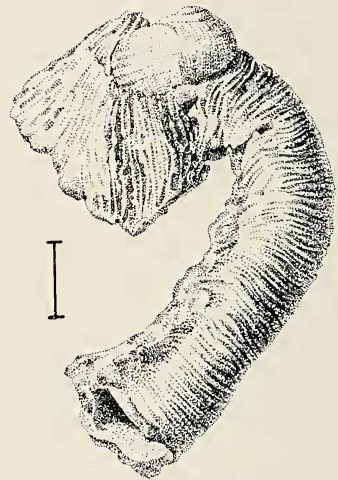


FIG. 25. *Magilus antiquus* Montfort. Composite drawing of two specimens from Saipan, Mariana Islands (USNM 595414).

*M. antiquus* is a mollusk of curious behavior and specific habitat. It begins life as a free-living gastropod with a symmetrically shaped shell but soon settles upon living coral, becomes embedded, and develops an extraordinary shell. As the coral grows, *M. antiquus* secretes a tubelike extension of its aperture. It stops up its original shell with calcareous material, then vacates it, and lives in the free end of the tube, which extends to and opens upon the surface of the coral. It is not known

whether *M. antiquus* obtains nourishment directly from the coral or whether it receives its food from the surrounding water through the open tube.

Both the primary shell and its tubular extension are calcareous and chalky white. The primary shell is typically about 1 inch long; the tube may be as long as 6 inches.

The recent Micronesian collections contain only two specimens, taken alive in 5 to 10 feet of water from the lagoon off Mañagaha Island, Saipan. They were obtained from a solid head of living *Goniastrea retiformis* (Lamarck) by breaking open the coral.

**GEOGRAPHIC RANGE:** USNM records are from Mauritius, Ceylon, Cocos-Keeling Atoll, Java, southern Japan, and Saipan only. Reported from northern Australia and from Hawaii. *M. antiquus* is probably more abundant than the above records indicate but has rarely been collected because of its inconspicuous mode of life.

#### Genus MAGILOPSIS Sowerby, 1919

*Magilopsis lamarcki* (Deshayes, 1863).

Hirase and Taki (1951) pl. 111, fig. 18 [as *Leptoconchus lamarkii* Deshayes]; Tinker (1952) p. 104, 3 figs. on p. 105 [as *Leptoconchus lamarkii* Deshayes].

Uncommon in collections, probably because it lives embedded in coral and, consequently, has been overlooked. The shell of *M. lamarcki* is thin, elongate, characteristically chalky white, and about an inch long. Unlike *Magilus antiquus*, it does not secrete a tube.

Among the specimens studied, one was collected by Morrison at Eniwetok, slightly below low tide line on the leeward lagoon reef flat. He reports that *M. lamarcki* occurs in burrows in living coral, oriented apex down. The burrows have only a small opening at the coral surface, like the holes of boring clams of the genus *Lithophaga*. At Raroia Atoll, in the Tuamotus, Morrison

found the commensal clam *Barclayia incerta* (Deshayes) living in the same burrow with *M. lamarcki*. They were embedded at the base of coral (*Acropora* spp.) on the leeward ocean reef flat. Specimens from Saipan were embedded, apex down, in slightly irregular burrows in living *Goniastrea retiformis* Lamarck. A single dead specimen was found at Onotoa on living coral in 5 to 20 feet of water in a pass through the leeward reef. USNM specimens from Hawaii, collected by Ditlev Thaanum, were taken from a depth of 150 to 300 feet off Waikiki. They also were embedded in coral. Thaanum observed that the shells were unattached but the burrows were so narrow the mollusks could not turn within them.

The eggs of *M. lamarcki* are laid in capsules and remain within the parental burrow until they hatch into pelagic larvae, which eventually settle on coral and form their own chambers.

**GEOGRAPHIC RANGE:** Collection records for *M. lamarcki* are few, but they indicate a widespread occurrence in the Indo-Pacific. USNM specimens are from Mauritius in the Indian Ocean and from the Mariana, Marshall, Gilbert, Hawaiian, and Tuamotu islands in the Pacific. The species is reported also from southern Japan and Formosa.

#### Family COLUMBELLIDAE—Dove Shells

##### Genus COLUMBELLA Lamarck, 1799

*Columbella turturina* Lamarck, 1822.

Kira (1955) pl. 28, fig. 6.

Characteristically about one-half inch long with a yellow or whitish exterior, a white aperture, and pink outer and inner lips.

Lives on small lagoon reefs at depths of 10 to 30 feet. Two specimens in the recent Micronesian collections were found living on colonies of *Seriatopora* sp.

**GEOGRAPHIC RANGE:** USNM records are from Ceylon and Cocos-Keeling Atoll eastward to Hawaii and Samoa, and from southern Japan south to northern Australia and the Loyalty Islands. Uncommon in Micronesia.

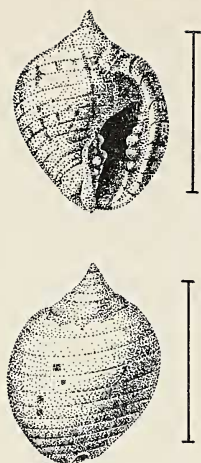


FIG. 26. *Columbella turturina* Lamarck. Onotoa Atoll, Gilbert Islands (USNM 607538).

Family BUCCINIDAE—Buccinid Snails

Genus CANTHARUS Röding, 1798

Subgenus POLLIA Sowerby, 1834

*Cantbarus (Pollia) fumosus* (Dillwyn, 1817).

Characteristically 0.75 to 1.5 inches long. Closely resembles *C. undosus* with its raised brown spiral cords, white aperture with orange lips, and hairy periostracum. However, *C. fumosus* is more elongate and, unlike *C. undosus*, possesses axial ribs.

The recent Micronesian collections include only one lot of four specimens taken among intertidal rocks of Tomil Harbor beach, Yap Island.



FIG. 27. *Cantbarus (Pollia) fumosus* (Dillwyn). Cebu, Philippines (USNM 419449).

GEOGRAPHIC RANGE: Apparently more widespread than *C. undosus*, particularly in the Indian Ocean where *C. undosus* is reported only from Cocos-Keeling Atoll. USNM records are from Mauritius, the Red Sea, and the coast of India, eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan south to New Guinea and Fiji. Uncommon in Micronesia. Not reported from Hawaii.

*Cantbarus (Pollia) undosus* (Linné, 1758).

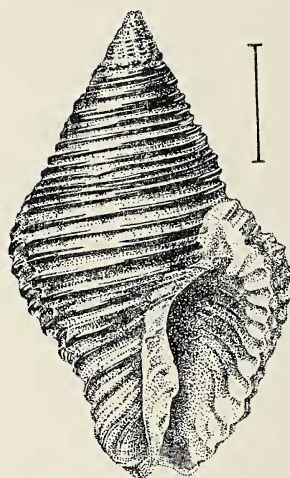


FIG. 28. *Cantbarus (Pollia) undosus* (Linné). Luzon, Philippines (USNM 303327).

Characteristically about one and one-half inches long with numerous, dark brown, evenly spaced, raised spiral cords on all whorls and typically covered with a hairy periostracum. Aperture white with dark orange lips. Resembles *C. fumosus* but may be distinguished from that species by its broader shell and its complete lack of axial ribs.

*C. undosus* ordinarily lives in rock crevices on seaward reef flats, near or a few feet below low tide line. It also occurs in reef flat tide pools above low tide line and on small lagoon reefs at depths of a few feet.

GEOGRAPHIC RANGE: USNM collections are from Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands, and from the Marianas south to New Guinea and the



Loyalty Islands. Reported from southern Japan and the Great Barrier Reef, Australia, but not from Hawaii. Fairly common in Micronesia.

Genus *ENGINA* Gray, 1839

*Engina mendicaria* (Linné, 1758).

Hirase and Taki (1951) pl. 105, fig. 8.

Characteristically one-half inch long and blackish brown with spiral yellowish-white bands and a brown aperture.

Ordinarily lives under rocks near or just below low tide line on seaward reef flats, both windward and leeward. Also found in rocky tide pools across the entire reef flat.

GEOGRAPHIC RANGE: USNM records for this common Indo-Pacific species are from the Red Sea and Mauritius eastward through the Indian and Pacific oceans to Samoa, and from southern Japan and Hawaii south to the Loyalty and Tonga islands.

Genus *COLUBRARIA* Schumacher, 1817

*Colubraria strepta* Cossmann, 1903.

Hirase and Taki (1951) pl. 105, fig. 2;

Tinker (1952) p. 80, 2 figs. on p. 81.

Characteristically 1.5 to 2 inches long.

The only specimen in the recent Micronesian collections was taken off Ine Village, Arno Atoll, on rocks on a small lagoon reef in about 6 feet of water.

GEOGRAPHIC RANGE: Apparently limited to the Pacific and uncommon in Micronesia. USNM records are from New Guinea, the Marshall, Line, Hawaiian, and Tuamotu islands, and from Fiji and Samoa.

Genus *CADUCIFER* Dall, 1904

*Caducifer decapitatus* (Reeve, 1844).

Characteristically about three-fourths inch long. Columnar in shape and white with thin brown axial ribs interrupted by a few white spiral lines. Invariably found with its apex broken.



FIG. 29. *Caducifer decapitatus* (Reeve). Oshima Osumi, Japan (USNM 273493).

At Onotoa and Saipan *C. decapitatus* was collected from crannies in both living and dead coral on small lagoon reefs and in shallow passes between seaward reefs. At Arno Atoll, it was found on branching coral (*Pocillopora* sp.) off the seaward reef edge. It ordinarily lives below low tide line, commonly at depths of 4 to 10 feet.

GEOGRAPHIC RANGE: USNM records are from Mauritius, southern Japan, and the Mariana, Gilbert, Fiji, Samoan and Hawaiian islands. Uncommon in Micronesia.

Family *NASSARIIDAE*—Mud Snails

Genus *NASSARIUS* Dumeril, 1806

*Nassarius crenelliferus* (A. Adams, 1851).

Characteristically 0.75 to slightly less than 1 inch long and grayish with two indistinct dark brown spiral color bands on the body whorl. Outer lip and parietal callus polished white.

The recent Micronesian collections contain only one specimen which was found living

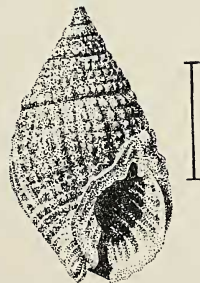


FIG. 30. *Nassarius crenelliferus* (A. Adams). Yap Island, western Carolines (USNM 614204).

among intertidal rocks on the beach at Tomil Harbor, Yap.

GEOGRAPHIC RANGE: USNM records of this uncommon Micronesian species are from southern Japan, the Gulf of Siam, and the Caroline Islands. Not reported from Australia or Hawaii.

*Nassarius jonasi* (Dunker, 1846).

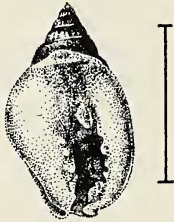


FIG. 31. *Nassarius jonasi* (Dunker.) Yap Island, western Carolines (USNM 614205),

Characteristically 0.5 to 0.75 inch long with a conspicuous parietal callus and prominent axial ribs on the body whorl. Shell medium brown. Callus, lips, and teeth polished white.

According to Allan (1950), *N. jonasi* lives in estuaries and lagoons and is ordinarily found in shallow water among seaweed. The recent Micronesian collections only contain one specimen, an individual found living among intertidal rocks on the beach at Tomil Harbor, Yap.

GEOGRAPHIC RANGE: The above-mentioned specimen from the Caroline Islands is the only USNM record. Reported from northern Australia and New South Wales, but not from Hawaii. Uncommon in Micronesia.

*Nassarius papillosus* (Linné, 1758).

Tinker (1952) p. 82, 2 figs. on p. 83; Morris (1952) p. 190, pl. 39, fig. 16.

Characteristically about 1.5 to 2 inches long and light brown or fawn-colored with conspicuous white nodules.

Ordinarily lives on sandy lagoon floors and in sand pockets on small lagoon reefs, ranging from low tide line to depths of 10 or 20 feet. One specimen was collected at Onotoa from a sand pocket below low tide line on the

leeward ocean reef. Apparently *N. papillosus* is a carnivorous scavenger which feeds upon other mollusks and upon decaying organic matter. It is frequently collected from lobster traps to which it is presumably attracted by the bait.

GEOGRAPHIC RANGE: USNM records of this fairly common Micronesian species are from Mauritius, Cocos-Keeling Atoll, Hong Kong, southern Japan, and from the Philippine, Caroline, Gilbert, Line, and Hawaiian islands. Reported from northern Australia.

Family FASCIOLARIIDAE—Spindle Shells

Genus FASCIOLARIA Lamarck, 1799

*Fasciolaria filamentosa* (Röding, 1798).

Hirase and Taki (1951) pl. 99, fig. 12.

Characteristically 4 to 6 inches long and yellowish or flesh-colored with many dark brown spiral grooves.

Lives among coral below low tide line off the outer edge of seaward reefs.

GEOGRAPHIC RANGE: USNM records are from Tanganyika, East Africa, Mauritius and Cocos-Keeling Atoll in the Indian Ocean, and from the Ryukyu, Palau, Caroline and Marshall islands in the Pacific. Reported from Australia but not from Hawaii. Fairly common in Micronesia.

Genus LATIRUS Montfort, 1810

*Latirus barclayi* (Reeve, 1847).

Adult specimens characteristically measure 2 to 4 inches long. Shell whitish with a straw-colored periostracum and commonly dark brown between the broad axial nodes. Aperture white within.

Lives on sandy lagoon bottoms and among rocks on seaward reef flats, from near low tide line to depths of 20 feet.

GEOGRAPHIC RANGE: USNM records are from Mauritius, Cocos-Keeling Atoll, the Philippine, Mariana, and Marshall islands, and from Samoa and Fiji. Uncommon in Micronesia. Not reported from Hawaii.

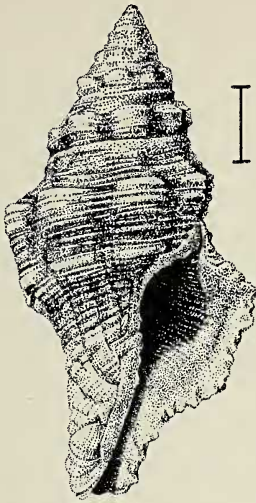


FIG. 32. *Latirus barclayi* (Reeve). Guam, Mariana Islands (USNM 487445).

Genus PERISTERNIA Mörch, 1852

*Peristernia chlorostoma* (Wood, 1828).

Tinker (1952) p. 76, 3 figs. on p. 77.

Characteristically 0.75 to 1 inch long with a canary yellow aperture.

*P. chlorostoma* lives on seaward and lagoon reef flats, both windward and leeward, among rocks and loose coral, in tide pools, and on the sandy-rocky reef surface. It is most commonly found near low tide line on seaward reef flats, just shoreward of the reef edge.

GEOGRAPHIC RANGE: Apparently limited to the Pacific. USNM records are from the Marshall, Phoenix, Samoan, and Tuamotu islands only. Reported from Hawaii. There are many USNM specimens from the Marshall Islands, but none from elsewhere in Micronesia.

*Peristernia nassatula* (Lamarck, 1822).

Hirase and Taki (1951) pl. 100, fig. 5.

Characteristically 1.25 to 1.5 inches long with a violet aperture.

*P. nassatula* ordinarily lives in rock crevices on seaward reef flats. However, one specimen in the recent Micronesian collections was taken by Cloud at night on the intertidal lagoon sand flats of Uliga Island, Majuro Atoll.

GEOGRAPHIC RANGE: USNM collections are from Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society and Tuamotu islands, and from southern Japan, the Philippine and Mariana islands south to the Loyalty Islands and Fiji. Fairly common in Micronesia. There are USNM specimens from the Line Islands, but none from Hawaii. Reported from the Great Barrier Reef, Australia.

Family MITRIDAE—Miter Shells

Genus MITRA Lamarck, 1799

*Mitra (Mitra) mitra* (Linné, 1758) (syn. *episcopalis* Linné, 1758).

Hirase and Taki (1951) pl. 100, fig. 13;

Tinker (1952) p. 52, figs. on p. 53 [as *M. episcopalis* Linné].

The largest *Mitra* in the Indo-Pacific, commonly attaining a length of 6 inches. Shell smooth and white with conspicuous orange spots.

*M. mitra* typically lives on sandy lagoon shores in shallow water but is also found in sand pockets on shallow seaward reef flats. It ordinarily remains buried during the day and is active at night.

GEOGRAPHIC RANGE: USNM collections are from East Africa throughout the Indian and Pacific oceans to the Society and Tuamotu islands, and from the Ryukyu and Hawaiian islands south to the Great Barrier Reef, Australia, and New Caledonia. Common in Micronesia. Reported from southern Japan.

*Mitra (Mitra) stictica* (Link, 1807) (syn. *pontificalis* Lamarck, 1811; *thiara* Wood, 1825).

Hirase and Taki (1951) pl. 100, fig. 12;

Tinker (1952) p. 54, 3 figs. on p. 55.

Characteristically 2.5 to 3 inches long, white with squarish orange-colored blocks, and nodulose below the sutures.

Ordinarily lives in sand pockets on seaward reef flats, slightly below low tide line. Also found at depths of 5 to 15 feet in grooves

and surge channels just seaward of the reef edge. Like *M. mitra*, *M. stictica* remains buried during the day but comes out at night.

**GEOGRAPHIC RANGE:** USNM collections are from East Africa throughout the Indian and Pacific oceans to the Society and Tuamotu islands, and from the Ryukyu and Hawaiian islands south to New Guinea and New Caledonia. Reported from northern Australia. Apparently more common than *M. mitra* in Micronesia.

Subgenus SWAINSONIA H. and A. Adams,  
1853

*Mitra (Swainsonia) casta* (Gmelin, 1791).

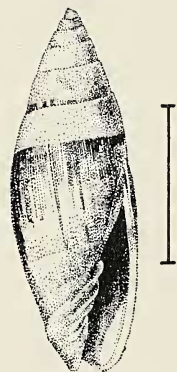


FIG. 33. *Mitra (Swainsonia) casta* Gmelin. Ifaluk Atoll, Caroline Islands (USNM 614201).

Characteristically 1 to 2 inches long, smooth and white with dark brown bands above each suture, the brown coloring ordinarily being worn away, particularly on the body whorl.

One specimen in the recent Micronesian collections was found living in sand between small reefs on the sandy lagoon slope at Ifaluk in about 10 feet of water. A dead specimen was dredged from the bottom of Bikini lagoon in 18 to 30 feet of water.

**GEOGRAPHIC RANGE:** USNM records are from the Philippine, Caroline, Marshall, Fiji, Samoan, Tuamotu, and Marquesas islands. Reported from southern Japan and from the Loyalty Islands (Bouge and Dautzenberg,

1922), but not from Hawaii. Uncommon in Micronesia.

Genus STRIGATELLA Swainson, 1840

*Strigatella litterata* (Lamarck, 1811) (syn. *bizonalis* Lamarck, 1822).

Hirase and Taki (1951) pl. 101, fig. 9;

Morris (1952) p. 195, pl. 39, fig. 17 (poor).

Characteristically 1 to 1.5 inches long with yellowish-white hieroglyphic markings.

Ordinarily lives below low tide line among rocks on seaward reef flats. Also found in tide pools and moist rock crevices across the entire reef flat. Records in recent Micronesian collections indicate that *S. litterata* is most plentiful on windward ocean reefs or windward lagoon reefs of broad atolls, although it has also been taken on leeward reefs.

**GEOGRAPHIC RANGE:** According to USNM records and published reports, *S. litterata* is distributed from East Africa (Natal, Durban, South Africa to the Red Sea) eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to the East Indies, New Caledonia, and the Loyalty Islands. Not reported from Australia. Very common in Micronesia.

*Strigatella lutea* (Quoy and Gaimard, 1833) (syn. *acuminata* Swainson, 1824, not Gmelin, 1791).

Tinker (1952) p. 64, fig. on p. 65 [as *M. acuminata* Swainson].

Characteristically about one inch long and dull yellow in color.

Lives in rocky tide pools on seaward and lagoon reef flats, windward and leeward.

**GEOGRAPHIC RANGE:** USNM collections are from Mauritius eastward through the Pacific to the Society and Tuamotu islands, and from southern Japan and Hawaii south to New Guinea and the Solomons. Reported from New Caledonia but not from Australia. Uncommon in Micronesia.

*Strigatella paupercula* (Linné, 1758).

Hirase and Taki (1951) pl. 101, fig. 11 [as *Mitra zebra* Lamarck].

Characteristically 1 to 1.5 inches long with a variable color pattern of yellowish-white longitudinal stripes on a dark blackish-brown background.

Lives among rocks and in tide pools of seaward reef flats, ranging from the extreme seaward edge of the flat to the upper intertidal zone. Most frequently taken on windward reefs but also found on leeward reefs. Abbott (1950) reports this species from shallow, lagoon waters at Cocos-Keeling Atoll.

GEOGRAPHIC RANGE: USNM collections are from East Africa and the Red Sea through the Indian and Pacific oceans to Samoa, and from southern Japan and Palmyra south to the East Indies and New Caledonia. Reported from Hawaii and northern Australia. Fairly common in Micronesia.

Genus VEXILLUM Röding, 1798

*Vexillum (Vexillum) gruneri* (Reeve, 1844).

Characteristically about one inch long and white with narrow brown spiral bands.

Frequently found intertidally along sandy lagoon shores. The recent Micronesian collections include two specimens taken at night—one from the intertidal lagoon shore of



FIG. 34. *Vexillum (Vexillum) gruneri* (Reeve). Ifaluk Atoll, Caroline Islands (USNM 614200).

Uluga Island, Majuro Atoll, and another from a lagoon sandspit at Ifaluk. One specimen was dredged from 72 feet of water off the seaward shore of Bikini Island.

GEOGRAPHIC RANGE: USNM records are from southern Japan, the Philippine, Caroline, and Marshall islands, Samoa, and New Caledonia. Reported from northern Australia but not from Hawaii. Uncommon in Micronesia.

*Vexillum (Vexillum) plicaria* (Linné, 1758).

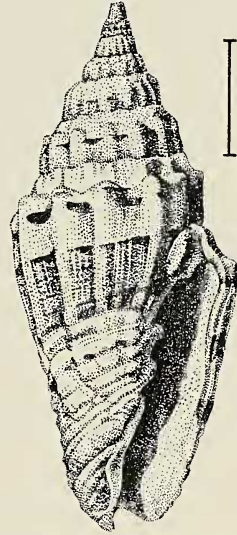


FIG. 35. *Vexillum (Vexillum) plicaria* Linné. Andaman Islands (USNM 305600).

Characteristically about one and one-half inches long and white with dark brown bands and a dark brown apex.

The recent Micronesian collections contain only one worn specimen, dredged from four feet of water off Yaptown, Yap. Specimens from the Philippines in the U. S. National Museum collections were dredged from a depth of 60 feet.

GEOGRAPHIC RANGE: USNM collections are from the Andaman Islands and the East Indies to New Guinea, Fiji, and southern Japan. Reported from northern Australia but not from Hawaii. Uncommon in Micronesia.

Subgenus COSTELLARIA Swainson, 1840

*Vexillum (Costellaria) exasperata* (Gmelin, 1791).

Tinker (1952) p. 56, 3 figs. on p. 57.

Characteristically 0.5 to 0.75 inch long. Grayish or whitish with strong axial ribs shouldered below the suture and crossed by many fine spiral grooves. The axial ribs are commonly whitish at the shoulders and occasionally brown in the middle of the whorl. Aperture white with four columellar plications.

Lives in sandy lagoons from low tide line to depths of 150 feet.

**GEOGRAPHIC RANGE:** According to USNM collections and published reports, distributed from South Africa and the Red Sea eastward through the Indian and Pacific oceans to the Marquesas Islands, and from the Ryukyu and Hawaiian islands south to the East Indies, New Caledonia, and the Loyalty Islands. Not reported from Australia. Uncommon in Micronesia.

#### Genus PUSIA Swainson, 1840

*Pusia nodosa* (Swainson, 1840).

Tinker (1952) p. 62, 2 figs. on p. 63.

Characteristically about one-half inch long and white with a yellow aperture.

Lives among rocks and in tide pools across seaward reef flats, ranging from just shoreward of the reef edge to the upper intertidal zone. Specimens in the recent Micronesian collections were taken from both windward and leeward ocean reefs but not from lagoon reefs.

**GEOGRAPHIC RANGE:** USNM collections are from Mauritius eastward through the Pacific to the Society and Tuamotu islands, and from southern Japan and Hawaii south to the Caroline Islands and New Caledonia. Not reported from East Africa or Australia. Fairly common in Micronesia.

#### Genus SCABRICOLA Swainson, 1840

Subgenus CHRYSAME H. and A. Adams, 1853

*Scabricola (Chrysame) cucumerina* (Lamarck, 1811) (syn. *ferrugata* Wood, 1825).

Tinker (1952) p. 62, 3 figs. on p. 63.

Characteristically 0.5 to 1 inch long and orange-red with white blotches.

Ordinarily lives among rocks and in tide pools of windward ocean reef flats, at or near low tide line. Not reported from lagoon reefs.

**GEOGRAPHIC RANGE:** USNM collections of this common Micronesian species are from Mauritius eastward through the Pacific to the Hawaiian and Tuamotu islands, and from the Ryukyu Islands south to New Guinea and New Caledonia. Reported from northern Australia.

*Scabricola (Chrysame) pertusa* (Linné, 1758).

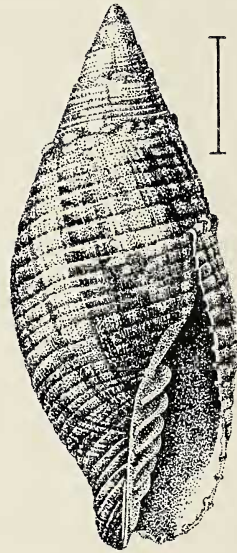


FIG. 36. *Scabricola (Chrysame) pertusa* (Linné). Ifaluk Atoll, Caroline Islands (USNM 614203).

Characteristically about 1.5 to 2 inches long and brownish or yellowish with conspicuous incised spiral lines and nodulose sutures.

There is a single specimen from Ifaluk in the recent Micronesian collections. It was found living in a sand pocket on the windward ocean reef flat, below low tide line in water about one foot deep.

**GEOGRAPHIC RANGE:** USNM records of this uncommon Micronesian species are from the East Indies, Philippines, Marquesas, Samoa, Mariana, and Caroline islands. Not reported from Hawaii.

Family VASIDAE—Vase Shells

Genus VASUM Röding, 1798

*Vasum ceramicum* (Linné, 1758).

Hirase and Taki (1951) pl. 99, fig. 8.

Much larger and higher spired than the commoner *V. turbinellus*. Typically 3 to 5 inches long.

The recent Micronesian collections include only two specimens, both of which were taken alive from rocks below low tide line on the windward lagoon reef flats at Ifaluk.

**GEOGRAPHIC RANGE:** Apparently limited to the Pacific and uncommon in Micronesia. USNM records are from the Philippine, Mariana, Caroline, Marshall and Gilbert islands, New Guinea, New Caledonia, Fiji, Samoa and Niaufoou. Reported from the Ryukyu Islands and northern Australia but not from Hawaii.

*Vasum turbinellus* (Linné, 1758) (syn. *nigra* Perry, 1811; *cornigera* Lamarck, 1822).

Hirase and Taki (1951) pl. 99, fig. 9.

A heavy, low-spired shell, characteristically 2.5 to 3 inches long.

According to records with the recent Micronesian collections, *V. turbinellus* lives in a variety of habitats. It is apparently most abundant on seaward reef flats, both windward and leeward, where it lives among rocks and in crannies in both living and dead coral. The species is commonly found in turbulent water just shoreward of the reef edge, but it also occurs in tide pools across the entire reef flat, ranging into the upper intertidal zone. In addition, it has been taken from surge channels of seaward reefs, on windward lagoon reef flats, on shallow small lagoon reefs, along exposed rocky beaches, and among seaweed on sandy lagoon shelves. It is frequently so heavily encrusted with coralline algae, Foraminifera, vermetids, and *Hipponyx* as to be difficult to distinguish from the reef surface.

**GEOGRAPHIC RANGE:** USNM collections are from the Red Sea and Mauritius eastward through the Indian and Pacific oceans to

Samoa, and from the south China coast, the Ryukyu and Mariana islands south to New Caledonia. Reported from northern Australia but not from Hawaii. Very common in Micronesia.

Family CONIDAE—Cone Shells

Genus CONUS Linné, 1758

*Conus adamsoni* Broderip, 1836 (syn. *rhododendron* Couthouy, 1839).

Platt (1949) col. pl. on p. 73, fig. 5 [*as C. rhododendron*].

A very rare species. In the entire USNM collections there are only two specimens, one taken at Samoa by the U. S. Exploring Expedition, the other given by natives to collectors at Onotoa. There is no specific locality or ecologic data for either specimen. The species is reported from Australia (Platt, 1949), but not from Hawaii.

*Conus arenatus* Hwass, 1792.

Characteristically 1 to 2.25 inches long, coronate, and white with many fine, brown, spirally arranged spots that occasionally form a zig-zag or banded pattern.

The recent Micronesian collections contain only two worn specimens from Tomil Harbor, Yap; one from four feet of water in the harbor, the other from among dead coral heads on the tidal flat.

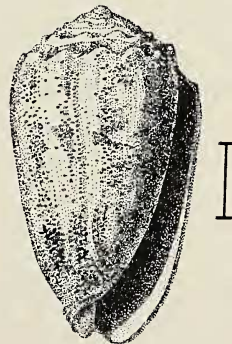


FIG. 37. *Conus arenatus* Hwass. Cebu, Philippines (USNM 303520).

GEOGRAPHIC RANGE: USNM collections are from all along the east African coast, eastward through the Indian and Pacific oceans to the Cook Islands, and from southern Japan south to northern Australia; but the species is uncommon in Micronesia. Not found in Hawaii.

*Conus aulicus* Linné, 1758 (syn. *episcopus* Hwass, 1789).

Platt (1949) p. 53, col. fig. 17; Kira (1955) pl. 37, fig. 14.

Characteristically 1.75 to 6 inches long and reddish-brown with white tent-shaped markings. Although some workers consider *C. episcopus* Hwass to be a distinct species, it is here considered synonymous with *C. aulicus*.

Lives among rocks on seaward reef flats, ordinarily along windward shores. Like many cones, *C. aulicus* has a venomous bite. An account of poisonous cone species, of wounds received, and of the biting mechanism is given by Clench and Kondo (1946). Like most cones, *C. aulicus* is nocturnal.

GEOGRAPHIC RANGE: USNM records are from Cocos-Keeling Atoll eastward through the Pacific to the Tuamotu Islands, and from the Ryukyu Islands south to northern Australia and New Caledonia, but the species is uncommon in Micronesia. Not found in Hawaii.

*Conus capitaneus* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 3.

Characteristically 1.25 to 2.5 inches long. The recent Micronesian collections include only three worn specimens. One was dredged from Tomil Harbor, Yap. Another was found among beach drift at Burok Island, Rongelap. The third, for which there is no specific locality data, is from Ifaluk.

GEOGRAPHIC RANGE: According to USNM records and published reports, this uncommon Micronesian species is found all along the African coast, eastward through the Indian and Pacific oceans to Tonga and Samoa; and from southern Japan, the Mariana, and Mar-

shall islands south to eastern Australia. Not reported from Hawaii.

*Conus catus* Hwass, 1789.

Tinker (1952) p. 34, 2 figs. on p. 35; Kira (1955) pl. 36, fig. 16.

Characteristically 1.5 to 2.5 inches long and dark brown with irregular white spots.

Ordinarily lives under rocks and loose coral on windward ocean reef flats. Not reported from lagoon reefs.

GEOGRAPHIC RANGE: According to USNM records and published reports, this common Indo-Pacific cone occurs from Africa and the Red Sea eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus chaldeus* (Röding, 1798) (syn. *vermiculatus* Lamarck, 1822).

Tinker (1952) p. 44, 2 figs. on p. 45 [as *C. vermiculatus*]; Kira (1955) pl. 36, fig. 11.

Characteristically 0.75 to 1.25 inches long. Body whorl white with dark brown, elongate vertical markings. Resembles, and is commonly found with, *C. ebraeus*, but may be distinguished from that species by the elongate markings on its shell which are unlike the squarish color blocks of *C. ebraeus*.

Ordinarily lives among rocks on seaward reef flats, both windward and leeward, but also reported from exposed, windward lagoon reef flats. Characteristically found below low tide line, generally in the extreme seaward zones of the reef, but also occurs in tide pools across the reef flat.

GEOGRAPHIC RANGE: USNM records of this common Indo-Pacific species are from East Africa and Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to the East Indies, New Guinea, and Fiji. Reported from northern Australia.





FIG. 38. *Conus coronalis* (Röding). Ifaluk Atoll, Caroline Islands (USNM 614199).

*Conus coronalis* (Röding, 1798) (syn. *piperatus* Reeve, 1844).

Characteristically 0.66 to 1.25 inches long. Body whorl bluish-gray with irregular brown flammules, spiral grooves, and granules. Spire coronate. Resembles *C. miliaris* but may be distinguished from that species by the dark brown coloration within its aperture and the dark brown flammules on its body whorl.

Ordinarily lives among rocks on windward ocean reef flats, generally at or near low tide line just shoreward of the reef edge. Not reported from lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM collections of this common Micronesian species are from the entire east African coast eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from the Ryukyu and Line islands south to the East Indies, New Guinea, and New Caledonia. Not reported from Australia or from southern Japan. Not found in Hawaii.

*Conus distans* Hwass, 1792.

Tinker (1952) p. 32, 2 figs. on p. 33; Kira (1955) pl. 37, fig. 4.

Characteristically 2.25 to 4 inches long and covered with a heavy yellowish periostracum. Resembles *C. virgo* but may be distinguished from that species by its coronate spire.

Ordinarily lives among rocks on seaward reef flats near or below low tide line. Apparently most abundant on the outer portion of windward ocean reef flats but also taken on the seaward reef edge, in tide pools across

the entire seaward reef flat, and in shallow water on lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM records are from the Philippines eastward through the Pacific to the Hawaiian and Society islands; and from the Ryukyu Islands south to New Guinea and the New Hebrides. Although fairly common in Micronesia, it is not reported from Australia or southern Japan.

*Conus ebraeus* Linné, 1758.

Hirase and Taki (1951) pl. 113, fig. 12; Tinker (1952) p. 34, 2 figs. on p. 35; Morris (1952) p. 202, col. pl. 7, fig. 4 [as *C. hebraeus*]; Kira (1955) pl. 36, fig. 9.

Characteristically 0.75 to 1.75 inches long, although Hawaiian specimens reach a length of 2 inches. White with squarish black color blocks.

Ordinarily lives among rocks or in holes and grooves on seaward reef flats, both windward and leeward. Typically occurs in fairly shallow water all across the reef flat and just seaward of the reef edge. Occasionally found on lagoon reef flats and on small reefs on lagoon floors.

**GEOGRAPHIC RANGE:** USNM collections of this very common Indo-Pacific cone are from the entire east African coast (including the Red Sea), eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia. According to Greene (1953), a live specimen was taken by Ted Dranga off the coast of Guanacosta Province, Costa Rica, Hertlein and Emerson (1953) report *C. ebraeus* from Clipperton Island in the eastern Pacific.

*Conus eburneus* Hwass, 1789.

Hirase and Taki (1951) pl. 113, fig. 15; Kira (1955) pl. 36, fig. 2.

Characteristically 1 to 2.75 inches long.

The recent Micronesian collections include worn specimens from Eniwetok, Rongelap, Saipan, and Yap, but only one specimen taken alive. It was collected at night by

Cloud on the intertidal lagoon shore of Uliga Island, Majuro Atoll.

**GEOGRAPHIC RANGE:** According to USNM records and published reports, distributed from Madagascar and Mauritius, eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan, the Mariana and Marshall islands, south to northern Australia and New Caledonia. Uncommon in Micronesia and not reported from Hawaii.

*Conus flavidus* Lamarck, 1810.

Tinker (1952) p. 38, 2 figs. on p. 39; Morris (1952) p. 204, col. pl. 7, fig. 6.

Characteristically 1 to 2.5 inches long. Resembles *C. lividus* with its purple aperture and medial white apertural band, but may be distinguished from that species by its smooth, noncoronate spire.

Ordinarily lives on seaward reef flats, among rocks near or slightly below low tide line, or in intertidal pools. Also taken in surge channels through the edge of seaward reefs and on lagoon reef flats. Apparently most abundant along windward shores.

**GEOGRAPHIC RANGE:** USNM collections and published reports indicate this common Indo-Pacific species to be distributed from the east African coast (including the Red Sea and Persian Gulf) eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia. One of the most common cones in Hawaii.

*Conus imperialis* Linné, 1758.

Hirase and Taki (1951) pl. 113, fig. 9; Tinker (1952) p. 32, 2 figs. on p. 33; Morris (1952) p. 199, col. pl. 7, fig. 5; Kira (1955) pl. 36, fig. 8.

Characteristically 2 to 3.75 inches long.

Ordinarily found among rocks near low tide line on windward ocean reef flats. Also taken from surge channels through the edge of seaward reefs. Not reported from lagoon shores.

**GEOGRAPHIC RANGE:** According to USNM collections and published reports, distributed from Mauritius eastward through the Indian and Pacific oceans to the Tuamotu and Marquesas islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia. Uncommon in Micronesia.

*Conus leopardus* (Röding, 1798) (syn. *millepunctatus* Lamarck, 1822).

Tinker (1952) p. 30, 3 figs. on p. 31 [as *C. litteratus*].

Characteristically 2.5 to 6.5 inches long. See *C. litteratus* for further description.

Three live specimens were taken at Bikini Atoll, two on the lagoon reef flat, below low tide line, and one on the sandy lagoon floor at a depth of 10 feet.

**GEOGRAPHIC RANGE:** Because this species has been confused with *C. litteratus*, the range here is based only on specimens in the USNM collections. They indicate that *C. leopardus* is distributed from Mauritius in the Indian Ocean eastward through the Pacific to the Society and Marquesas islands, and from the Ryukyu and Hawaiian islands south to the Celebes and New Caledonia. It is apparently uncommon in Micronesia.

*Conus litteratus* Linné, 1758.

Hirase and Taki (1951) pl. 113, fig. 16.

Characteristically 2.5 to 5 inches long. *C. litteratus* and *C. leopardus* are commonly confused. Both are white with dark brown spots, but they differ in the appearance of the basal portion of their apertures. The tip of *C. leopardus* is truncated and white within, whereas that of *C. litteratus* is pointed and dark purple-brown within.

The recent Micronesian collections include only one group of individuals found living among small reefs in 3 to 4 feet of water on the sandy lagoon shelf at Ifaluk. These reefs are never out of water, even at low tide.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate distribution from the east African coast (including the

Red Sea) eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan, the Mariana, and Marshall islands south to northern Australia and New Caledonia. Uncommon in Micronesia and not reported from Hawaii.

*Conus lividus* Hwass, 1792.

Tinker (1952) p. 38, 2 figs. on p. 39; Morris (1952) p. 203, col. pl. 7, fig. 13; Hirase and Taki (1951) pl. 114, fig. 9.

Characteristically 1 to 2.5 inches long. Closely resembles *C. flavidus* with its purple aperture and the medial white band within its aperture, but may be distinguished from that species by its coronate, tuberculated spire.

Ordinarily lives under rocks on seaward reef flats. Invariably occurs below low tide line in water from a few inches to a few feet deep.

GEOGRAPHIC RANGE: USNM collections and published reports indicate that this common Indo-Pacific species occurs all along the east African coast (including the Red Sea and Persian Gulf), eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia. It is especially common in Hawaii.

*Conus magus* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 8.

Characteristically 1.25 to 3.25 inches long.

The recent Micronesian material includes only five specimens. They were collected alive at night by Cloud from the intertidal zone of the sandy lagoon shore at Uliga Island, Majuro Atoll.

GEOGRAPHIC RANGE: According to USNM collections and published reports, distributed from Zanzibar on the east African coast, eastward through the Indian and Pacific oceans to the Tuamotu Islands; and from southern Japan and the Marshall Islands south to northern Australia and New Caledonia. Not

reported from Hawaii. Uncommon in Micronesia.

*Conus marmoreus* Linné, 1758.

Hirase and Taki (1951) pl. 113, fig. 10;  
Tinker (1952) p. 30, 2 figs. on p. 31;  
Kira (1955) pl. 36, fig. 6.

Characteristically 1.75 to 4.5 inches long.

Ordinarily lives among rocks below low tide line on seaward reef flats, both windward and leeward. Also common on lagoon reef flats and at depths of 5 to 15 feet on sandy lagoon shelves or slopes, among turtle grass or small reefs and in a few feet of water on lagoon reef flats. Nocturnal, venomous.

GEOGRAPHIC RANGE: USNM collections and published records indicate this common Micronesian species to be distributed from Madagascar and Mauritius eastward throughout the Indian and Pacific oceans to the Tuamotu Islands, and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus miles* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 5;  
Tinker (1952) p. 34, 2 figs. on p. 35;  
Morris (1952) p. 202, col. pl. 7, fig. 11;  
Kira (1955) pl. 36, fig. 23.

Characteristically 1.25 to 3.5 inches long.

Ordinarily found among rocks below low tide line on seaward reef flats, commonly just shoreward of the reef edge. Also taken on small lagoon reefs, in channels between seaward reef segments, and on lagoon reef flats. Apparently most abundant along windward shores.

GEOGRAPHIC RANGE: USNM collections and published records indicate this common Indo-Pacific species to be distributed from the east African coast (including the Red Sea), eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus miliaris* Hwass, 1792.

Characteristically 0.75 to 1.25 inches long. Body whorl pinkish with two white, interrupted bands, numerous spiral grooves and granules, and a yellowish epidermis. Spire coronate. Resembles *C. coronalis* but may be distinguished from that species by the light pink color within its aperture and the absence of dark brown flammules on its body whorl.<sup>3</sup>

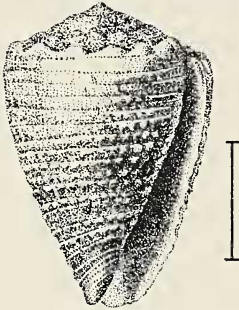


FIG. 39. *Conus miliaris* Hwass. Abamama Atoll, Gilbert Islands (USNM 433980).

Ordinarily lives among rocks on seaward reef flats, both windward and leeward, typically at or near low tide line or in tide pools. Also found on lagoon reef flats and among small reefs on sandy lagoon shelves.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this fairly abundant Micronesian species to be distributed from all along the east African coast (including the Red Sea), eastward through the Indian and Pacific oceans to the Society and Tuamotu islands, and from southern Japan and Palmyra south to the East Indies and New Caledonia. Not reported from Australia. There is a single USNM specimen from Hawaii, but the occurrence of *C. similaris* in Hawaii needs confirmation by additional collecting.

*Conus mustelinus* Hwass, 1792.

Characteristically 1 to 2.25 inches long.

<sup>3</sup> An endemic Hawaiian cone, *C. abbreviatus* Reeve, 1843 [Tinker (1952), figs. on p. 41], is closely related to both *C. miliaris* and *C. coronalis*. It is medium in color, covered with small distinct brown dots in regular rows, without flammules, but with dark-brown in the aperture. It is recorded only from Midway to the Hawaiian Islands.

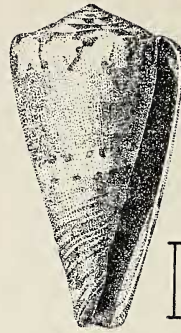


FIG. 40. *Conus mustelinus* Hwass. Cebu, Philippines (USNM 614195).

Body whorl straw-colored with a set of 2 or 3 spiral rows of dark brown spots on a white band around the middle and a second white band at the shoulder irregularly marked with brown flammules or spots. Spire smooth with many broad brown flammules.

The recent Micronesian collections include only two worn specimens from Yap; one dredged from four feet of water at Yaptown, the other taken from dead coral heads in Tomil Harbor. Probably lives below low tide line.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this uncommon species to be distributed from Madagascar and Mauritius eastward through the Indian and Pacific oceans to Samoa, and from southern Japan and the Ryukyu Islands south to northern Australia and New Caledonia. Not reported from Hawaii.

*Conus pulicarius* Hwass, 1792.

Hirase and Taki (1951) pl. 113, fig. 11;

Tinker (1952) p. 36, 2 figs. on p. 37;

Morris (1952) p. 203, col. pl. 7, fig. 2;

Kira (1955) pl. 36, fig. 15.

Characteristically 1.25 to 2.25 inches long, coronate, and white with numerous dark brown dots.

Ordinarily lives below low tide line along sandy lagoon shores, on sandy seaward reef slopes, and in sand pockets on seaward and lagoon reef flats. The recent Micronesian collections contain the following specimens:

four lots taken among turtle grass and small reefs in 2 to 5 feet of water on the sandy lagoon shelf at Ifaluk; several specimens from off the seaward reef edge at Bikini in 36 to 90 feet of water; and a number of shells found below low tide line on lagoon reef flats at Eniwetok. USNM specimens from Hawaii were collected on seaward reef flats and off the edge of seaward reefs to a depth of 300 feet. *C. pulicarius* ordinarily remains buried during the day, characteristically about 2 to 4 inches beneath the sand, and moves about only at night.

**GEOGRAPHIC RANGE:** USNM collections of this common Indo-Pacific species are from Cocos-Keeling Atoll in the Indian Ocean eastward through the Pacific to the Society, Tuamotu, and Marquesas islands, and from southern Japan south to New Caledonia. Reported from northern Australia and from Hawaii.

*Conus quercinus* Hwass, 1792 (syn. *cingulum* Martyn, 1786, nonbinom.).

Tinker (1952) p. 28, 5 figs. on p. 29; Morris (1952) p. 202, col. pl. 7, fig. 12; Kira (1955) pl. 37, fig. 7.

Characteristically 1.25 to 4 inches long, although Hawaiian specimens occasionally attain a length of 5 inches.

The recent Micronesian collections include only one specimen obtained at Onotoa from a native and without specific locality data. According to Greene (1953), this species lives in groups and is seldom found in less than 20 feet of water.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate distribution from the east African coast (including the Red Sea and Persian Gulf), eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan and Hawaii south to the East Indies and New Caledonia. Not reported from Australia. Uncommon in Micronesia.

*Conus rattus* Hwass, 1792.

Tinker (1952) p. 38, 2 figs. on p. 39; Morris

(1952) p. 202, col. pl. 7, fig. 14; Kira (1955) pl. 36, fig. 19.

Characteristically 0.75 to 1.75 inches long.

Ordinarily lives near low tide line under rocks and in rocky tide pools on windward and leeward ocean reef flats. Also taken from lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate distribution of this common Indo-Pacific cone from South Africa and the Red Sea eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus sponsalis* Hwass, 1792.

Kira (1955) pl. 36, fig. 12.



FIG. 41. *Conus sponsalis* Hwass. Ifaluk Atoll, Caroline Islands (USNM 614194).

Characteristically 0.5 inch to slightly less than 1 inch long. Body whorl typically smooth above and spirally granulate below; white with dark brown, elongate, spirally arranged, axial flammules; and covered with a yellowish epidermis. Spire coronate. Aperture purple within.

Ordinarily lives among rocks on windward and leeward ocean reef flats, generally at or near low tide line or in tide pools. Apparently less abundant on lagoon reef flats.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this common Micronesian cone to be distributed from Mauritius throughout the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan south to northern Australia and New Caledonia. Not reported from Hawaii.

*Conus striatus* Linné, 1758.

Tinker (1952) p. 32, fig. on p. 33; Morris (1952) p. 199, col. pl. 7, fig. 1; Kira (1955) pl. 37, fig. 9.

Characteristically 2 to 4 inches long.

Only two specimens in the recent Micronesian collections were taken alive; one from the reef at the east side of Tomil Harbor, Yap, and the other from among small reefs on the sandy lagoon shelf at Ifaluk. Like many cones it is poisonous. Nocturnal.

**GEOGRAPHIC RANGE:** USNM collections and published records for this uncommon Indo-Pacific cone indicate distribution from East Africa (including the Red Sea and Persian Gulf) eastward through the Indian and Pacific oceans to the Society, Tuamotu, and Marquesas islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia. Uncommon in Micronesian collections, but may be locally abundant in some parts of the Indo-Pacific.

*Conus textile* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 15; Tinker (1952) p. 36, fig. on p. 37; Morris (1952) p. 199, col. pl. 7, fig. 19.

Characteristically 1.25 to 4.75 inches long.

The only specimen of *C. textile* in the recent Micronesian collections is a worn specimen from Puntan Muchot beach, leeward Saipan. Abbott (1950) reports that this species occurs on the outer shores of the main atoll at Cocos-Keeling. Instances of fatal poisoning from the bite of *C. textile* have been reported. The species is nocturnal.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this well-known but uncommon Indo-Pacific cone to be distributed from East Africa (including the Red Sea and Persian Gulf) eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus tulipa* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 18; Kira (1955) pl. 37, fig. 19.

Characteristically 1.25 to 3.25 inches long.

Ordinarily lives under rocks and coral on seaward reef flats, but also found on lagoon reef flats. *C. tulipa* has a poisonous bite. Nocturnal.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this rather common Micronesian species to be distributed from the Red Sea, the Seychelles, and Madagascar eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia.

*Conus vexillum* Gmelin, 1791.

Hirase and Taki (1951) pl. 114, fig. 6 [poor].

Characteristically 1.75 to 4.75 inches long, occasionally reaching a length of 6 inches.

The recent Micronesian collections contain only one specimen taken alive. It was found on the shallow seaward reef flat of leeward Onotoa. Abbott (1950) reports that a single specimen was found living on the outer shores of Cocos-Keeling Atoll.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate this uncommon Indo-Pacific species to be distributed from the Red Sea, Madagascar, and Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to New South Wales and New Caledonia.

*Conus virgo* Linné, 1758.

Hirase and Taki (1951) pl. 114, fig. 10; Kira (1955) pl. 37, fig. 10.

Characteristically 1.75 to 4 inches long.

The recent Micronesian collections contain only one specimen. It was found living in 3 or 4 feet of water on the leeward ocean reef flat of Onotoa.

**GEOGRAPHIC RANGE:** USNM collections and published records indicate distribution

from the east African coast (including the Red Sea) eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia. Uncommon in Micronesia.

*Conus vitulinus* Hwass, 1792.

Tinker (1952) p. 36, fig. on p. 37; Morris (1952) p. 202, col. pl. 7, fig. 17.

Characteristically 1 to 2.25 inches long.

Ordinarily lives among rocks and in tide pools on seaward reef flats. Also reported from lagoon reef flats.

GEOGRAPHIC RANGE: USNM collections and published records indicate this uncommon Indo-Pacific species to be distributed from Madagascar and Mauritius eastward through the Indian and Pacific oceans to the Society and Tuamotu islands; and from southern Japan and Hawaii south to northern Australia and New Caledonia.

#### Family TEREBRIDAE—Auger Shells

##### Genus TEREBRA Bruguière, 1789

*Terebra crenulata* (Linné, 1758).

Hirase and Taki (1951) pl. 116, fig. 10;

Tinker (1952) p. 10, 3 figs. on p. 11;

Kira (1955) pl. 38, fig. 16.

Characteristically 5 to 6 inches long and whitish or fawn-colored with crenulated sutures.

Ordinarily lives buried a few inches in the sand of lagoon shelves, in quiet shallow water, or in intertidal lagoon sand flats.

GEOGRAPHIC RANGE: According to USNM records this common Micronesian species is distributed from Cocos-Keeling Atoll eastward through the Pacific to Palmyra Atoll and Samoa, and from southern Japan south to the New Hebrides. Reported from the Red Sea, Persian Gulf, and Madagascar through the Indian and Pacific oceans to the Tuamotu and Marquesas islands, from Hawaii, and from northern Australia.

*Terebra dimidiata* (Linné, 1758).

Hirase and Taki (1951) pl. 116, fig. 3;

Tinker (1952) p. 14, fig. on p. 17; Kira (1955) pl. 38, fig. 17.

Characteristically 4 to 6 inches long, white with squarish orange markings on each whorl, and with a distinct spiral groove below each suture.

Habitat similar to that of *T. crenulata*.

GEOGRAPHIC RANGE: USNM collections of this common Micronesian *Terebra* range from Mauritius eastward through the Indian and Pacific oceans to the Hawaiian and Tuamotu islands, and from the Ryukyu Islands south to the Solomon and Fiji islands. It is reported from East Africa, Madagascar, the Seychelles, and Ceylon, from southern Japan, and from northern Australia.

*Terebra felina* (Dillwyn, 1817) (syn. *tigrina* Gmelin 1791 [in part]).

Hirase and Taki (1951) pl. 116, fig. 9;

Tinker (1952) p. 22, 2 figs. on p. 23 [as *T. tigrina* Gmelin]; Morris (1952) p. 198, pl. 40, fig. 7 [as *T. tigrina* Gmelin].

Characteristically less than three inches long and white with orange-brown spots and incised spiral grooves below each whorl.

The only specimen in the recent Micronesian collections was found living in shallow, quiet water on the sandy lagoon shelf of leeward Ifaluk.

GEOGRAPHIC RANGE: USNM collections are from the Ryukyu, Philippine, Caroline, and Marshall islands. Reported from East Africa, the Seychelles, Madagascar, Mauritius, New Caledonia and the Loyalty Islands, from Hawaii, and from northern Australia. Uncommon in Micronesia.

*Terebra guttata* (Röding, 1798) (syn. *oculata* Lamarck, 1822).

Hirase and Taki (1951) pl. 116, fig. 2 (as

*T. oculata* Lamarck); Tinker (1952) p. 12, fig. on p. 13 (as *T. oculata* Lamarck); Kira (1955) pl. 38, fig. 20.

Characteristically about five inches long and orange or fawn-colored with a single row of white spots below each suture.

Habitat similar to that of *T. maculata*, *T. dimidiata*, and *T. crenulata*. Also, Allan (1950) reports this species living in sand on coral reefs.

**GEOGRAPHIC RANGE:** USNM collections are from the East Indies eastward throughout the Pacific to the Society Islands, and from the Philippine and Mariana islands south to Fiji. Uncommon in Micronesia. Reported from the Ryukyus, northern Australia, and Hawaii.

*Terebra maculata* (Linné, 1758).

Hirase and Taki (1951) pl. 116, fig. 7;

Tinker (1952) p. 12, fig. on p. 13; Morris (1952) p. 197, pl. 40, fig. 2; Kira (1955) pl. 38, fig. 21.

The largest Indo-Pacific *Terebra*, characteristically 6 to 8 inches long. White or flesh-colored with dark brown or purplish splotches.

Like *T. crenulata* and *T. dimidiata*, *T. maculata* is ordinarily found buried a few inches in the sand of lagoon shelves, in quiet shallow water, or in lagoon sand flats which are exposed at extreme low tide.

**GEOGRAPHIC RANGE:** USNM collections of this very common Micronesian *Terebra* are distributed from East Africa eastward through the Indian and Pacific oceans to the Hawaiian and Society islands, and from the Ryukyu and Bonin islands south to New Caledonia. It is also reported from the Persian Gulf, the Red Sea, India, and Ceylon, from southern Japan, and from northern Australia.

*Terebra striata* Quoy and Gaimard, 1833 (syn. *affinis* Gray, 1834).

A small species, characteristically 1 to 1.5 inches long. White with brown transverse streaks and numerous, closely spaced, incised transverse grooves. A spiral groove is present below each suture.

Ordinarily found buried in the sand of lagoon shelves in shallow, quiet water or in lagoon sand flats which are exposed at ex-



FIG. 42. *Terebra striata* Quoy and Gaimard. Composite drawing of two specimens from Ifaluk Atoll, Caroline Islands (USNM 614196).

treme low water. Also found, though less frequently, in sand pockets between coral patches on seaward reef flats.

**GEOGRAPHIC RANGE:** USNM collections are from the Ryukyu, Philippine, Mariana, Caroline, Marshall, Gilbert, Fiji, Cook, Society, and Tuamotu islands. Although *T. striata* is uncommon in most Micronesian collections, the recent ones include several specimens. Not reported from Hawaii.

*Terebra subulata* (Linné, 1758).

Hirase and Taki (1951) pl. 116, fig. 1;

Tinker (1952) p. 12, fig. on p. 13; Morris (1952) p. 197, pl. 40, fig. 4; Kira (1955) pl. 38, fig. 19.

Characteristically 4 to 6 inches long and whitish with three rows of squarish dark brown spots on its body whorl.

Habitat similar to that of *T. maculata*, *T. crenulata*, and *T. dimidiata*. In addition, Allan (1950) reports this species to be abundant in sand pockets on the reefs of northern Australia.

**GEOGRAPHIC RANGE:** USNM collections are from the East Indies eastward throughout the Pacific to the Hawaiian and Tuamotu islands, and from the Ryukyu Islands south to New Caledonia. Reported from East Africa, the Red Sea, Ceylon, the Andaman Islands, and



northern Australia. Fairly common in Micronesia.

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